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WORLD PETROLEUM

Geology and Economic Significance of Burma Oilfields • Devaluation Encouraging to World Oil Trade • Japanese Oil Concession in North Sakhalin Renewed for Five Year Period • J. E. F. deKok Succeeds Sir Henri Deterding as Shell Head

NOVEMBER • 1936

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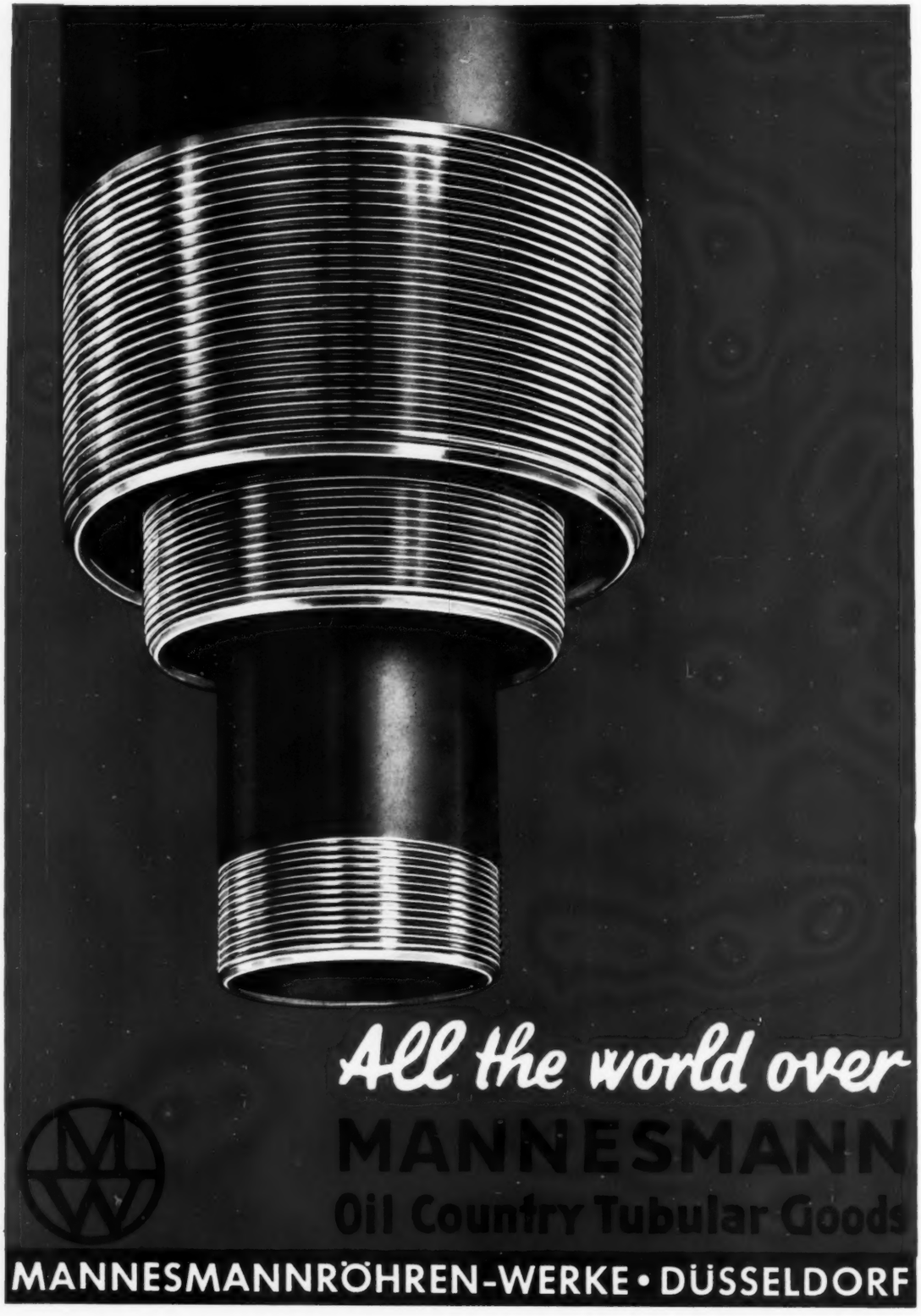
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CONTENTS

Frontispiece 574

Editorial 575

Foreign Oil Legion 593

Abstracts 598

World Oil Production 606

Special Articles

Soviet-Japanese Concession in Sakhalin Renewed 577

A New Oil Continent in the Pacific? 578

Geology and Economic Significance of Burmah Oilfields
By Dr. L. Dudley Stamp 580

Sir Henri Deterding Succeeded by J. E. F. de Kok 593

Devaluation's Effect on the Oil Industry 594

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PETROLEUM

Studying U. S. Crude Stocks

AT THE end of 1929 stocks of crude oil in storage in the United States were reported as 428,000,000 bbl. Since that time there has been a more or less continuous decrease down to the present. In 1934 net withdrawals were roundly 20,000,000 bbl. and in 1935 they were 25,000,000 bbl. Early in 1936 the United States Bureau of Mines began including in its reports estimates of unreported stocks which added some 16,000,000 bbl. to the total. On a basis comparable with that used in former years crude stocks had declined by 22,000,000 bbl. from January 1, 1936, up to mid-October, although the grand total stands at 292,000,000 bbl. or only 6,000,000 bbl. less than the published figure for December 31, 1935, when unreported stocks were disregarded.

A question raised by this sustained and more or less steady decline in storage is how much further it can be carried before stored supplies will be down to the level which it is necessary to maintain for the ordinary working needs of the oil industry. Another question which has been the subject of debate between representatives of the interstate compact and officials of the Bureau of Mines is whether or not reported stocks in storage are all available for use in manufacture. It has been maintained by some of the state representatives that fully 30 percent of the reported total consisted of bottoms, pipeline fill and water, and therefore was incapable of being converted into usable petroleum products.

Both these questions are now in the way of receiving answers through a survey that is being made by the Bureau of Mines under a special appropriation made by Congress at its last session. Questionnaires have been sent out to all the holders of storage oil so far as these can be ascertained, asking for a full report on the quantity and grades of oil held, while a field force of the Bureau will follow up this inquiry by sampling the oil in the 15,000 tanks, the pipelines and the refinery storage in which it is contained. In view of the amount of work entailed by this survey the results are not likely to be made public until perhaps the middle of 1937. It should lead, however, to an accurate picture of the conditions actually existing in this important phase of the American petroleum situation. It may reveal that surplus oil in store has ceased to constitute a menace to stability. In this connection it is interesting to note that none of the dire predictions of chaos in the crude industry that attended the overthrow of the NRA has been realized.

Stocks and Future Prices

THE real significance of statistics relating to supplies in store depends, of course, upon their relation to actual trade requirements. Their chief interest to members of the industry lies in observance of their upward or downward trend. With the growth in the volume of petroleum business and the demand for petroleum products the quantity of crude required for pipeline operation, for refinery working stocks, and as an indispensable reserve against possible emergencies, naturally increases. It is only the excess above these amounts, of which the item last named naturally is somewhat indeterminate, that constitutes a real surplus or that is capable of exerting a depressing influence upon prices.

Whether the usable supply of crude in storage at the present time is 292,000,000 bbl., or more nearly 200,000,000 bbl. when deductions are made for wastes and other allowances, it is beyond dispute that there exists a level somewhere below which it is impracticable to reduce these stocks without interfering with the regular operations of the industry. Some well informed observers hold the opinion that not more than 25 to 30 percent of the total quantity shown by official reports to be in existence can be so classified. If their view is correct the petroleum trade of the United States is approaching the time when it will have to depend upon enlarged production rather than further withdrawals from storage to meet increases in demand. Accepting the accuracy of the present reported total of stored supplies it is easy to compute that 30 percent of these is only 90,000,000 bbl., which is only 30 days' supply for the country as consumption has been running in recent months.

If production is maintained at its present level during the months of lessened consumption that lie just ahead, some accumulation of crude or finished stocks is to be anticipated. Some observers are inclined to see in recent maneuvers of the chairman of the Texas Railroad Commission a purpose to limit output temporarily in order to force a rise in the price level, while paving the way to a later increase in allowables. A price advance during the period of low consumption might very possibly defeat its own purpose, but students of the situation are inclined to agree that a further gain in motor fuel demand during 1937, even though not rising to the same proportionate height as during the current year, will bring about an increase in the prices of crude and, as a necessary consequence, in those of products also.

Proration Practice

SHOULD a substantial increase in production prove to be warranted, it may have an effect in enabling the present system of proration to maintain itself longer than otherwise would be the case. It is obvious, however, to those who have followed this subject that the method of fixing allowables on the basis of the total number of wells is certain to run into serious obstacles in the near future. If continued without modification it must lead ultimately to a breakdown in the system or else work serious injury to large numbers of producers.

In Texas, for example, the rapid extension of drilling has brought the authorized daily output per well down to an average of 18 bbl. Expert opinion holds that if this downward movement is carried very much further it will seriously impair the life of large numbers of wells. If the growth in demand for petroleum products is sufficient to halt the lowering of the per well allowable it may avoid this danger temporarily, but only temporarily if drilling continues at its present intensive rate.

Many suggestions have been made looking to the adoption of a more logical and equitable method of applying proration, such as the introduction of a per acre rather than a per well basis, taking into account the special physical characteristics of different fields and utilizing other scientific methods of equalizing the output of different pools. So long as production is regulated among individual wells by a process of simple division the only way in which producers can increase their output is by adding to the number of their wells, but since every such addition detracts from the allowable for each well the multiplication of outlets defeats itself and the only gainers in the race are those who can outdistance their competitors in the speed and extent of their drilling operations.

Another alarming result of the present system is its unbalancing effect upon the capital structure of producing companies. The only way in which the cost of sinking a well can be recovered is through sale of its output. If the reduction in allowable reduces the daily output permitted to this well by 50 percent, the owner must drill a second one to maintain the same production he originally had. With the same daily outturn his capital investment in production is doubled. Continuation of this process presently raises his capital charges to such a point that profitable operation will become impossible except with repeated increases in selling prices.

Thus in two directions the system of proration which has been in general use works to the disadvantage of producers and consumers as well. Revision of existing methods is one of the problems to which early and serious attention should be directed both by members of the industry and by those who are charged with its regulation.

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Sir Henri Deterding

AFTER forty years of service to his company and to the industry in which it has become a leading factor, Sir Henri Deterding has laid down the reins of authority which he has handled so long and with such masterful success. For many years he has been a foremost figure in international oil affairs—no mean distinction in itself when one considers how abundantly supplied with men of forceful character and strong individuality the petroleum trade has been during this period.

In building up the Royal Dutch Company into one of the world's leading corporations Sir Henri has displayed both boldness and sagacity. In this process of expansion he has crossed swords with many of the leading figures in the industry. They all have found him a worthy foeman, a sturdy fighter, but one who was always ready to join in peaceful and constructive measures wherever these were proposed.

By reason of its constitution the Royal Dutch Company has been under the close personal direction of its general managing director. Sir Henri was often referred to as one of the few business men, if not the only one, who conducted business in every country of the world. His knowledge of conditions in all these far-spread fields was astonishingly complete and accurate. From his modest office in St. Helen's Court, far less pretentious than those occupied by many men of lesser position, radiated the direction and control of the entire vast organization of the Royal Dutch-Shell Group. Because of the extent of their operations and because of the personal influence exercised by its occupant, this small room was in a very real sense the nerve centre of the petroleum industry.

While relinquishing the active direction of his company's affairs which he has exercised for more than a score of years, no one who knows this many-sided man will believe for a moment that he is retiring to what is conventionally termed a well-earned rest. Rather he is turning his alert and vigorous attention to other pursuits that have long interested him—to the education of youth, the encouragement of scientific farming and to the avocations of a connoisseur of art. That he may have before him many years of fruitful and enjoyable activity in these attractive fields is the sincere hope of his multitude of friends in the world of petroleum.

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Activities of the O.G.P.U.

WITH what eagerness the federal authorities look for anything of a damaging nature with which to link major oil companies is revealed as an interesting sidelight in the report of the Celeya Committee on hot oil activities in Texas. Reporting to the state legislature on October 22 the committee mentioned that, in its effort to trace any information that might indicate complicity on the part of any of the larger companies in producing or handling contraband oil, it learned that the federal petroleum agency had made an extensive investigation of this subject.

Following up this lead the committee found that the federal investigation had been directed especially toward one major pipeline company, that it had covered a period of twelve months, using as many as fifteen skilled operatives, and had combed the transactions of the company concerned in every state in which it conducted business. In the words of the committee, the federal agency spent "an enormous sum in defraying the expense of such investigation." Possibly, of course, a sum regarded as enormous by thrifty Texans would be considered only chicken-feed by free-spending Washington authorities.

It is significant that the results of the investigation never were made public. A possible reason may be found in the fact that it revealed an excess of only 5,000 bbl. handled by the pipeline company in the course of twelve months, or far less than the one percent overage allowed.

According to reports current in Washington this is only one of many "hidden" investigations that have been conducted in the effort to pin a charge of moral obloquy or legal infringement on the oil companies whose officials have been outspoken in their opposition to the federal administration's plans for control of the petroleum industry. Another indication of the same purpose is the statement that the suits brought by the Department of Justice against a large number of companies and officials for carrying out the expressed wishes of the petroleum administration are to be pushed energetically and an attempt made to find indictments against others.

Under the circumstances it is gratifying to members of the oil industry to know that so little ground for criticism or legal action has been found. Knowing as they now do the purposes and the animus of the federal administration, it behooves the oil companies not only to be good but to be careful.

Sakhalin—Tinder-Box of the Far East?

Extension of Japanese Oil Concession in North Sakhalin for Another Five Years Revives Question of Eventual Status of This Territory. Absolute Control Obviously Vital to Japan.

©Sovfoto

Admiral Sakonji, with M. L. Rukhimovich, signing the agreement which permits Japan to prospect for oil in North Sakhalin for another five years.

A SUPPLEMENTARY agreement to the Japanese North Sakhalin concession contract of December 14, 1925, was signed on October 10th in the offices of the Peoples Commissariat of Heavy Industry at Moscow by M. L. Rukhimovich, assistant Peoples Commissar for Heavy Industry, and Admiral Sakonji, chairman of the Japanese oil company operating in Sakhalin, Kita Karafuto Sekiu Kabushiki Kaisha (North Sakhalin Oil Company). By this supplementary agreement amending the concession contract, the holders of the concession are permitted to continue exploratory drilling for oil for another five years, the term fixed by the first agreement expiring in December, 1936. The original agreement is understood to have been amended to include clauses requiring an increased supply of Soviet labor and improved living quarters and conditions for these employees. After signing the new contract Admiral Sakonji and Mr. Rukhimovich assured each other that the renewal of the concession would strengthen the friendly and commercial ties between the two great nations and bring about better understanding.

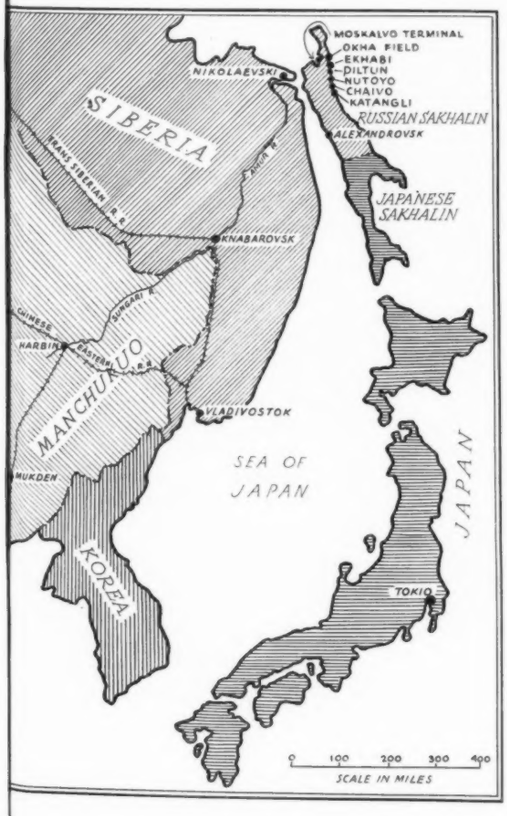
The importance to Japan of a dependable and easily accessible oil supply is apparent when one realizes that this country, largely dependent on maritime traffic for its commerce and national defense, consumes about 10,000,000 bbl. of oil yearly, of which less than 2,000,000 bbl. is produced within the country, the balance or 8,000,000 bbl. being imported largely from the fields of Netherland India and the United States.

Originally, Sakhalin was Chinese territory, but in 1857 the Russians took over the control of the island which they did not relinquish until the end of the Russo-Japanese war in 1905, when the southern portion was ceded to Japan in accordance with the Portsmouth treaty. In 1917 during the World War, Japan took possession of Russian Sakhalin and it was not until 1925 that it again became Russian territory. During the Japanese occupation of Russian Sakhalin, intensive studies were made of the prospective oil fields along the east coast and a clear idea was formed of their ultimate economic and strategic importance.

On December 8, 1925, Russia and Japan entered into a contract by which the latter acquired, for a term of 40 years, exploratory and drilling rights on eight tracts covering the semi-proven oilfields of northern Sakhalin, aggregating in area about 14,000 acres, these tracts being checker-boarded into 100-acre parcels, owned alternately by Russia and Japan. The contract also granted Japan, for 11 years, the exclusive right to explore the oil and natural gas resources on some 280,000 acres located in the same general region and to select, each year, within the area, an aggregate of 2,600 acres for oil development. This selected area was to be likewise checker-boarded and alternately owned in 100-acre parcels.

The contract provides for the payment by the Japanese of a minimum royalty of five percent on pumping wells when the total daily production reaches approximately 575 bbl., and a maximum royalty of 15 percent when the daily production aggregates 8,250 bbl. or more. The royalty on flowing wells runs from 15 percent when the daily production is 350 bbl. to 45 percent when it reaches 700 bbl. and over. The royalty on gasoline recovered from natural gas varies from 10 to 35 percent with the volume of gasoline recovered per 1,000 cubic ft. of gas. As can be seen from the foregoing, the contract is so decidedly advantageous to Russia as to make one wonder how the Japanese can operate their lands successfully. It seems problematical that they can do so in competition with Russia while she receives the royalties from the Japanese-owned parcels and retains the entire production from her own checker-boarded lots.

It seems inevitable that, sooner or later, northern Sakhalin and its oilfields will come under more rigid Japanese control. This conclusion seems to be justified on account of the importance to Japan of a domestic supply of oil which is so necessary in the Japanese program of national defense, as well as on account of the geographic location of this supply, and of the disadvantages to Japan in the present contract with Russia. An effort by Japan to take over northern Sakhalin would not be extraordinary as similar action was taken by Japan in 1917.



Sakhalin Crude Oil Production

	(bbl.)
1930	2,217,000
1931	2,532,000
1932	3,012,000
1933	3,409,000
1934	3,276,000
1935	2,800,000

A New Oil Continent in the Pacific?

Commonwealth of Australia Backs Oil Aspirations With a Subsidy of £250,000 For Drilling and Development of Petroleum Supplies From Various Domestic Sources.

TODAY, to all intents and purposes, national defense is almost synonymous with oil. No political unit seems to feel quite secure until an indigenous source of petroleum and products has been provided. The Commonwealth of Australia is no exception, and has recently appropriated £250,000 ($1,250,000) in connection with the Petroleum Oil Search Act 1936 to subsidize exploratory drilling in Australia and the adjacent island territories of Papua and New Guinea.

The continent of Australia, with an area of 2,974,581 square miles and 6,677,168 inhabitants, has been settled for 150 years only. Altogether the six states of the commonwealth embrace an area nearly as large as continental United States. Agricultural products are not dissimilar to those of the United States. The total mineral output up to the end of 1933 was valued at £1,251,651,200; of this, £646,406,900 was gold. The value of the production of the principal minerals in 1933 was: gold, £6,406,069; silver and lead, £2,570,262; copper, £531,153; tin, £540,331; and coal, £5,975,000. The increase in value of production of the manufacturing industries has more than doubled since the last pre-war year.

The action of the commonwealth government to encourage the development of oil supplies from various domestic sources may be briefly summarized under three heads: well oil, shale oil, and oil from coal.

Well Oil: As has been already mentioned, £250,000 was made available by the government in May, 1936, to subsidize exploratory drilling in Australia and the territories of Papua and New Guinea. A committee of technical experts has been appointed to advise the government upon the administration of the scheme. Applications for assistance will be reviewed by this committee and in approved cases, advances are to be made upon loan on a £ for £ basis. The funds have been appropriated under the Petroleum Oil Search Act 1936.

Shale Oil: Attention is being directed chiefly towards the working of the shale field at Newnes, New South Wales. Scientific investigations, however, have shown that petrol cannot be produced there at a cost to compete with imported refined oil, dutiable at 7d. per (imperial) gallon, unless protection is afforded in the form of exemption from payment of excise duty, now 5½d. per gallon. The commonwealth government, to offer encouragement for the development of a shale oil industry, has decided that production of petrol from shale in Australia up to a maximum of 10,000,000 gallons annually will be granted protection over imported petrol to the extent of customs and excise duties at present operating, for a period of 20 years. The effect of this will be that if either import duty on imported petrol, or excise duty on petrol refined from imported crude be reduced during the next 20 years, a bounty equivalent to the amount of such reduction will be paid by the government on petrol produced from Australian shale. Following this announcement, applications have been invited for the taking over of the government's option on plant, machinery, private railway, rolling stock and cottages on the Newnes field for the purpose of production and marketing of shale petrol. These works, which were constructed some years ago at an expenditure of £1,000,000, may now be acquired for £34,500 (£11,000 of which may be satisfied by an issue of shares in any company approved by the owner of the assets).

Oil From Coal: Developments abroad are being carefully watched by the government, and Sir David Rivett, chief executive officer of the Council for Scientific and Industrial Research (a government body), left Australia last May to investigate hydrogenation and low-temperature carbonization processes in England and Germany. The government is prepared to give serious consideration to the question of fostering production of oil from coal in Australia at such time as the methods now being employed overseas have been adequately tested.

According to authoritative information contained in announcements by the Prime Minister, the Rt. Hon. Joseph A. Lyons, structures favorable to well oil production have been found in Western Australia (Carnarvon, North-West Cape district and the Fitzroy River basin), Queensland (western portion including the Roma, Springsure and Longreach districts), New South Wales (Hawkesbury River and Hunter River district), Victoria (Gippsland basin and possibly portions of Central Australia), New Guinea (north of the Sepik River), and Papua (the Gulf and Delta divisions). It is considered essential that the government explore the possibilities of these sections, and it will confer with the states to evolve a plan to determine the possibilities of flow oil production in selected areas.

The general belief is that districts possessing similar geological conditions to some of those just mentioned above would if existing in other parts of the world, particularly in the United States, have been drilled many years ago, and that the time has come for the Australian government to devote attention to drilling.

Reports on shale oil have been obtained from the Newnes investigation committee and from Messrs. Crichton and Conacher, the Scottish shale oil experts. The estimated production of Newnes is shown as 7,250,000 gallons of petrol a year. In a national emergency the unit would be capable of immediately producing fuel oil for the navy.

Messrs. Crichton and Conacher's figures indicated that the landed cost at Sydney of Newnes petrol would be 12.09d. a gallon, allowing for working costs, transport, income taxation, dividends at six percent per annum, return of capital at the end of 20 years (which was the estimated life of the undertaking), a reserve fund for contingencies of one percent per annum, dividends during the construction period, and some restriction of output for the last three years. On the same basis, the Newnes committee's estimate was 10.06d. a gallon. The committee suggested that a mean figure of 11.075d. a gallon—a figure half-way between its estimate and that of Messrs. Crichton and Conacher—should be taken as the basis upon which to consider the proposal.

The committee said that the landed cost of comparable imported petrol in Sydney was 12.5d. a gallon, and that Newnes petrol would probably have to be disposed of to distributors at 1/ a gallon,

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General view of the gasoline plant at Clyde, New South Wales, where much of the motor fuel used in Australia is refined.

or one halfpenny a gallon below the price of the imported product, as an incentive to handling the commodity.

The Newnes committee suggested that, on its figures, the industry was capable of paying excise duty of 2d. a gallon after the first five years. If, however, the figure of 11.075d. was taken practically, no margin existed for excise duty.

The exemption of petrol produced at Newnes from excise duty for a period of 20 years would amount to a loss of revenue, calculated on the present excise of 5½d. a gallon, of about £3,300,000. Newnes would provide direct employment for about 400 men, so that the cost of developing the undertaking, based upon loss of excise duty, would amount to more than £400 a man a year.

Commenting on the proposal, the Newnes committee said that, on economic grounds, the establishment of the shale oil industry was not warranted, and that it could be justified only on the importance, for national considerations, of developing the Australian oil industry. The extent to which Australia could afford to exploit its own oil resources at this cost must depend upon national policy.

Imperial Chemical Industries, Ltd., according to another of Prime Minister Lyons' announcements, stated that another 12 months must elapse before sufficient was known about the production of petrol from coal to form definite conclusions about its economics. Preliminary information indicated that anything approaching an economic plant would have a capacity of 50,000,000 gallons of petrol a year. The capital cost of such a plant would be from £9,000,000 to £12,000,000, and it would provide employment as follows: staff, 350; process and maintenance labor, 2,600; coal miners, 460.

Subject to the confirmation of figures as a result of experience at Billingham-on-Tees, England, it is expected that the coal petrol industry can be developed in Australia only by complete exemption from excise duty—assuming that excise duty is maintained at the present level. Otherwise a subsidy, to make up the difference, will have to be paid—plus probably a direct subsidy of from 1d. to 2d. a gallon.

Minister for the Interior Paterson, when introducing the Petroleum Bill in the Australian House of Representatives last May, commented on the future position of the United States in the international oil picture. Quoting the opinions of leading authorities that supplies of well oil in U. S. A. were fast reaching the stage where America would no longer be an exporter of oil, the Minister said he was not suggesting that a world shortage of oil was imminent. It behooved the commonwealth government, however, if oil did exist in its territories, to bring it to production so that Australia might be able to fill the gap which would be created by the United States vacating the export field. It would add immeasurably to Australia's prosperity, the Minister continued, and would enable her to carry a substantially larger population.

The Lanywa oilfield in 1936, looking north. This is the reclaimed sandbank discussed in the text and indicated on the sketch at the top of page 591. Notice the grass planted in the foreground to fix the sand of the sandbank. (Photo courtesy of Indo-Burma Petroleum Co., Ltd.)

Geology and Economic Significance of Burma Oilfields

Seventh of a Series of Articles Dealing With the Geology, Production, Reserves and Economy of the More Important Oilfields Throughout the World. *By L. Dudley Stamp, D.Sc., M.I.P.T.**

HISTORICALLY the oilfields of Burma are interesting in many ways. Oil was known and used by the Burmans for their lamps at least in the 18th century. Major Michael Symes, who journeyed up the River Irrawaddy on a mission to the then independent kingdom of Ava, or Burma, in 1795, mentions the wells of Yenangyaung. Indeed the very name Yè-nan-chaung (water-stinking-creek or oil-creek) indicates the early acquaintance of the Burmans with oil, as indeed do such names as Yenangyat and Yenanma. The Yenangyaung field lay in the kingdom of Upper Burma until the annexation of that kingdom to British Burma in 1885. The following year the Burmah Oil Company was formed, so that this field has been exploited continuously by machine-bored wells since 1888, yet still remains the largest producing field in the country.

Burma has another claim to distinction in that the association of oil with anticlinal structures was observed by Dr. Thomas Oldham, the "father" of the Geological Survey of India, at Yenangyaung in 1855 and on the evidence collected he urged the possibilities at Yenangyat. After careful investigation G. E. Grimes, also of the Survey, in 1897

* Formerly Geological Adviser to the Indo-Burma Petroleum Company and the Yomah Oil Company; and Professor of Geology in the University of Rangoon.

Burma: Production of Petroleum

(In Imperial Gallons *)

Year	Whole of India, including Burma	Burma
1888	2,650,000	2,610,000
1889	2,950,000	2,900,000
1890	4,450,000	4,400,000
1891	5,800,000	5,780,000
1892	8,500,000	8,450,000
1893	10,200,000	10,100,000
1894	11,000,000	10,800,000
1895	13,200,000	13,100,000
1896	15,500,000	15,100,000
1897	18,000,000	17,600,000
1898	22,234,438	21,684,963
1899	32,934,007	32,309,531
1900	37,729,211	36,974,288
1901	50,075,117	49,441,734
1902	56,607,688	54,848,980
1903	87,859,069	85,328,491
1904	118,491,382	115,903,804
1905	144,798,444	142,063,846
1906	140,553,122	137,654,261
1907	152,045,677	148,888,002
1908	176,646,320	173,402,790
1909	233,678,087	230,396,617
1910	214,829,647	211,507,903
1911	225,792,094	222,225,531
1912	249,083,518	245,335,209
1913	277,555,225	272,865,397
1914	259,342,710	254,652,963
1915	287,093,576	282,291,932
1916	297,189,787	291,769,083
1917	282,759,523	272,795,191
1918	286,585,011	274,834,556
1919	305,749,138	293,846,129
1920	293,116,834	279,707,170
1921	305,683,227	296,092,057
1922	298,504,125	281,759,169
1923	294,215,053	271,405,947
1924	294,571,692	270,213,003
1925	289,606,542	262,828,930
1926	280,369,326	250,040,471
1927	281,113,909	245,904,044
1928	305,943,711	262,187,263
1929	306,148,093	253,400,524
1930	311,130,108	256,554,027
1931	305,018,751	243,914,568
1932	308,606,031	247,570,295
1933	306,009,022	249,000,899
1934	322,025,280	254,760,070

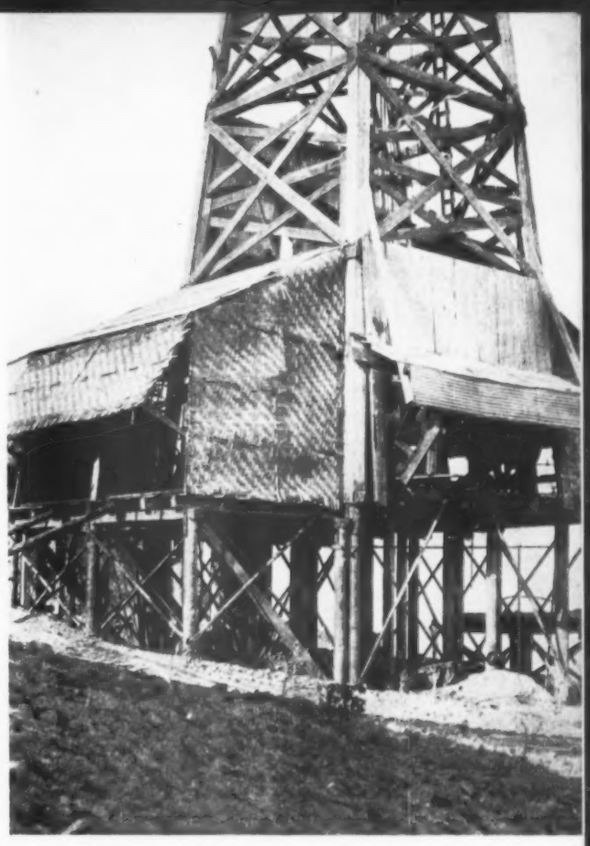
*Note: 249 imperial gallons=one metric ton of 7 bbl. (approx.).

stressed the possibilities of oil at the since famous field of Singu. Grimes never lived to know the success of his prophecy, for he died of cholera in 1898.

Although Burma has but two major producing fields, there has been but little change of output in the last 30 years and the fields afford the world's finest example of steady, conservative exploitation through limited government control and the consistent policy of private enterprise. As long ago as 1908 agreements were reached between the various oil companies concerned and the government (which is now regularly represented by the Warden of the Oilfields) to prevent wasteful competition. Burma holds yet another lesson—the value of intensive geological study. It was not until Yenangyaung had been exploited by modern methods and studied by successive generations of geologists for 40 years, that a slight asymmetry was detected and its effects calculated theoretically, with the result that the productive area has been doubled within the past few years.

Until the passing of the Government of India Act by the British Parliament in 1935, Burma was one of the provinces of the Indian Empire. Thus the mineral production of India included large quantities of oil, but the bulk came from Burma. There are small fields in Assam worked by the Assam Oil Co., Ltd. (Burmah Oil Co., Ltd.) and the Khaur field in the Punjab worked by the Attock Oil Co., Ltd., but the figures given in the accompanying table show that Burma's production is vastly more important. Now that Burma is becoming an independent unit of the British Empire, she will continue to vie with her old rival, Trinidad, and her newer rival, British Borneo, for the honor of being the largest producer in the empire. Although the production of crude oil in the country shows little change from year to year, owing to the rapid increase in world production Burma's share in world supplies has shown a steady percentage decrease—from 2.0 percent of the world's total in 1912 to 0.8 percent in 1925 and to less than 0.5 percent in 1935.

Burmese crude oil is too rich in the lighter fractions to be used as crude and almost the whole output is refined at the works at Syriam, on tidal water south of Rangoon, the oil being transported by pipeline or by oil-barges on the River Irrawaddy.



One of the B.O.C. wells on the shore of the Irrawaddy at Singu, with rig built on raised pier. The sketch below outlines the geography of Burma during Tertiary times as reviewed on page 582.

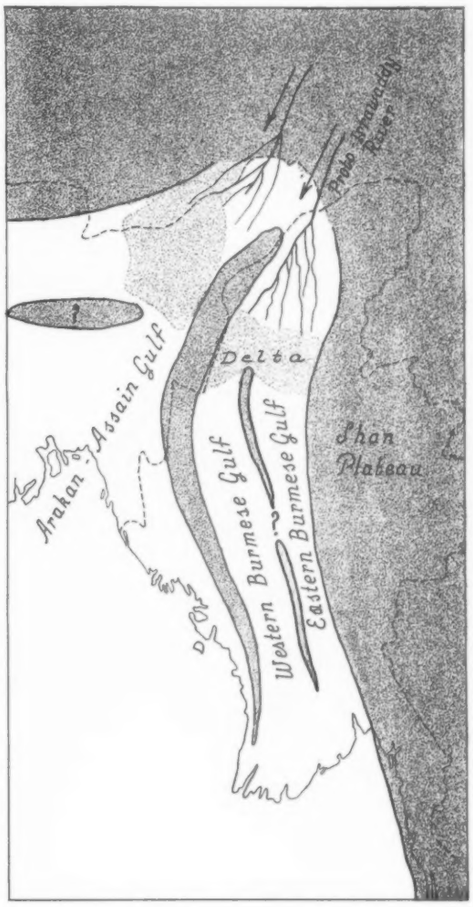
Outline of the Geology of Burma

THE general geology of Burma is relatively simple and controls the topography to such a marked extent that the natural geographical and geological units in the country closely correspond.

The country may be divided into four parts:

1. The Eastern Massif of Old Rocks. The whole of the east of the country, including the Shan states and Tenasserim, consists of a massif of hard, old rocks ranging in age from pre-Cambrian to Cretaceous. The whole area, with the exception of several old lake basins, has probably been land since the latter part of the Mesozoic. The massif forms a plateau with an average elevation of 3,000 ft. The western edge is clearly defined, being marked by the conspicuous line of hills familiar to every traveler by train from Rangoon to Mandalay. Along this line the Tertiary rocks dip sharply away from the old massif, but the junction is rarely visible.

2. The Western Fold Ranges. In the west of Burma the dominating feature is a great chain of fold mountains. The chain is complex and broad in the north, where it forms the Naga, Chin and other groups of hills; but southwards it narrows to form



General geological map of Burma showing the location of the various oilfields numbered 1–11 as in the table on page 583.

the Arakan Yoma. The actual physical structure terminates in Cape Negrais, but structurally the same fold continues through the Andaman and Nicobar Islands into Sumatra. In Burma several peaks reach 10,000 ft. Very little is yet known of the geology of the chain. The structure appears to be anticlinal, with a central core of crystalline rocks. Triassic, Jurassic and Cretaceous rocks are involved in the folding as well as the Tertiary sediments on the flanks. There is good reason to believe that the fold originated in Cretaceous or earlier times and grew gradually during the Alpine movements of the Tertiary period. The fold gave rise to a narrow land barrier from Eocene times onward.

3. The Central Tertiary Basin. Between the Arakan Yoma on the west and the Shan Plateau on the east lies the great region of Tertiary rocks in Burma. It corresponds roughly with the basins of the Chindwin-Irrawaddy and the Sittang rivers, and it is in this region that the petroliferous deposits of Burma are found.

4. The Arakan Tertiary Region. Between the Arakan Yoma and the Bay of Bengal lies another area of Tertiary rocks, forming a part of the Assam area of deposition.

In early Tertiary times Burma may be pictured as partly covered by a long narrow gulf of the sea, with the Shan Plateau forming the land mass on the east and the central ridge of the Arakan Yoma forming a narrow strip of land on the west. This strip of land may have been a peninsula separating the Burma and the Assam areas of deposition, or it may have been a long narrow island. In the latter case the retention of the term "Burma Gulf" is still justified because deltaic or freshwater conditions prevailed at the northern end.

More correctly one might refer to the Burma twin-gulf, for it was divided into two parts by a central, longitudinal ridge. The western portion corresponds roughly with the Chindwin-Lower Irrawaddy region of the present day; the narrower eastern portion with the upper Irrawaddy-Sittang region. The central ridge may have been only a submerged one, but it was sufficiently important to cause a marked difference in the deposits laid down in the eastern and western parts of the gulf. All the oilfields occur in the western gulf. The site of the old central ridge is marked today by a number of extinct volcanoes and, in the south, by the hills known as the Pegu Yomas.

The whole double gulf must have been broader than appears at the present day, owing to the extensive lateral compression and folding which has since taken place. The gulf was open to the sea on the south,

but into the northern end there probably poured several great rivers. Possibly the Tibetan course of the Brahmaputra is a remnant of this river system; at a later stage, rivers of which the Chindwin and the Irrawaddy are the modern representatives, took its place. The whole history of the Tertiary period in Burma may be summed up as the story of the infilling of the twin gulf by river-borne sediments from the north and by marine sediments in the south. On the whole, therefore, there has been a spreading of continental conditions from the north, pushing the marine waters further and further south. This process is still going on, and year by year the delta of the Irrawaddy encroaches on the shallow Gulf of Martaban.

The gradual infilling of the trough has, however, been interrupted at intervals by lateral folding movements. These movements resulted in the gradual uplift of the Arakan Yoma and, at a later stage, of the Pegu Yoma and other folds. Each movement of folding, however, caused a temporary increase of the depth of the center of the basin and a consequent return northward, in the center, of marine conditions. Thus it is found that the gradual retreat southward of the sea was interrupted at intervals by temporary northward movements which left their mark as wedges of marine strata tailing out northward. At the same time there is marked variation in the character of the deposits from east to west, across the gulf, and a certain amount of sediment must have been derived from the denudation of the Arakan Yoma land, while littoral conditions must have prevailed along its margins.

These lateral changes have a very definite bearing on the disposition of the Burmese oilfields. It is found that the freshwater sands (e.g. Irrawaddian) and freshwater clays, with remains of crocodiles, turtles and mammals, are entirely devoid of oil; the marine clays deposited under comparatively deep water are equally devoid of oil. All the petroliferous horizons are definitely associated with intermediate conditions. The old idea that the oil-bearing beds of Burma occupy a definite stratigraphical horizon is wholly fallacious. Not only are all horizons from the middle of the Eocene to the top of the Peguan (Oligo-miocene) petroliferous in at least certain points, but the oil in the existing fields of commercial importance is obtained from all horizons, from the base to the summit of the Peguan and probably from the higher Eocene. Further, any one petroliferous horizon is found rapidly to change its position relative to lithological or palaeontological horizons when traced laterally. Hence Burma abounds with examples of promising structures which have yielded nothing. There can be little doubt that this is due to the oncoming of more marine conditions experienced in any one horizon as one proceeds southward or to the oncoming of more continental conditions as one proceeds northward. Beds on the same horizon as the best oil sands of Yenangyaung are barren marine clays at Minbu or Ondwe, though these localities are only 20 or 30 miles to the south! Similarly beds on the same level as the rich oil sands of Singu are barren sands 10 or 20 miles to the north in the Yenangyat area.

Very broadly, the intermediate conditions suitable for oil formation seem to have persisted longest in the very heart of the western of the twin basins, in the neighborhood of Yenangyaung and Singu. To the south are many excellent structures, but there the oil-bearing sands are but minor episodes in a monotonous series of marine clays and shales. To the north the oil sands are but minor episodes in a great series of freshwater clays and sands.

Before proceeding to some account of existing oilfields, two points deserve emphasis. One is that the rapid alternation of beds of impervious clay and porous sands which characterizes the Peguan almost precludes the possibility of extensive *vertical* migration of oil. The evidence supports the view that the oil of Burma originated in the beds in which it is now found and only *lateral* migration has been important. The second point is to mention that the Tertiary sequence of Burma is usually divided into Eocene, Peguan (Oligocene-Miocene, predominantly marine) and Irrawaddian (Mio-Pliocene, mainly freshwater sands).

Individual Oilfields of Burma

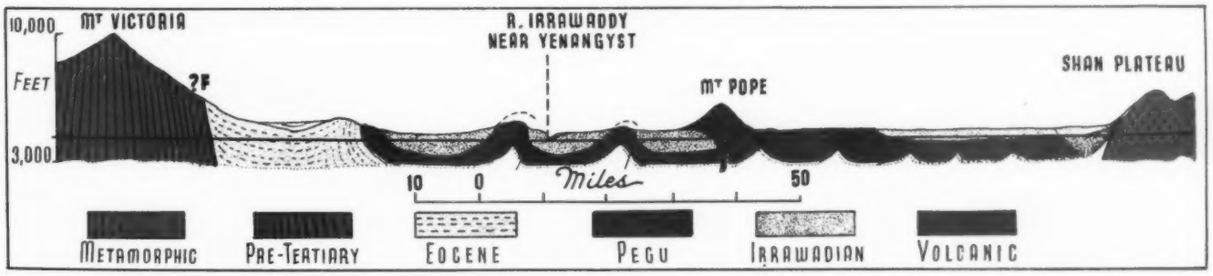
IGNORING the small production from the Arakan coastal regions, it may be said there are, at present, 11 producing oilfields in Burma. These fields and their production are listed in the accompanying table. It will be seen that there are only two major fields (Yenangyaung and Singu-Lanywa). Despite the most intensive geological investigations and exploratory drilling, no new field has been located in the last fifteen years, and it is becoming increasingly doubtful whether a new field of any significance remains to be detected.

Producing Oilfields of Burma

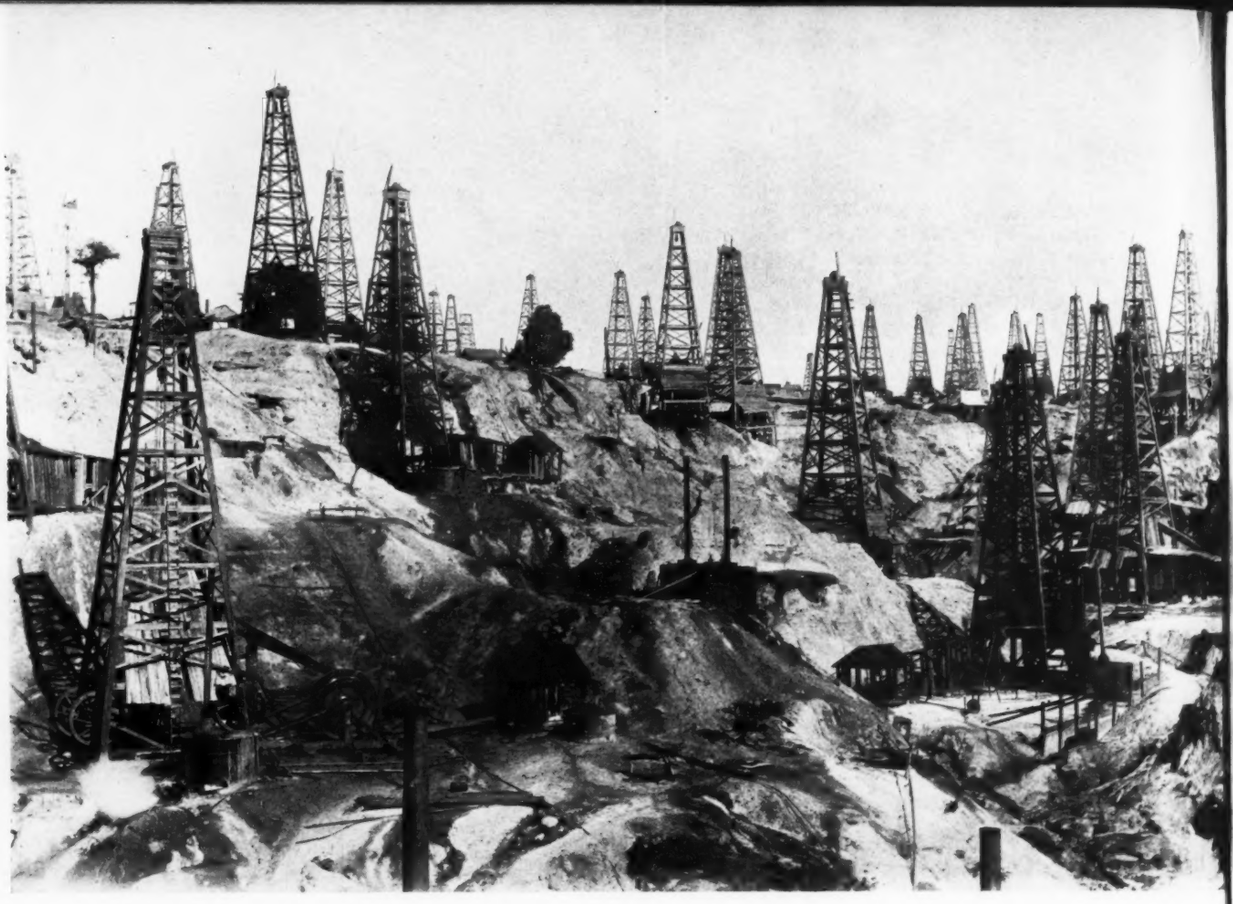
	Production in 1934 (Millions of gallons)	Approximate total production to end of 1935 (Millions of gallons)
(1) Yenangyaung	137.4	4,100
(2) Singu (structurally includes Lanywa)	81.9	2,350
(3–5) Yenangyat (Sabé, Yenangyat proper and Lanywa)	27.7	300
(6–8) Minbu (Minbu town, Palanyon and Yethaya)	3.9	100
(9) Indaw	3.1	40
(10) Yenanma	0.7	14
(11) Padaukbin		

Yenangyaung

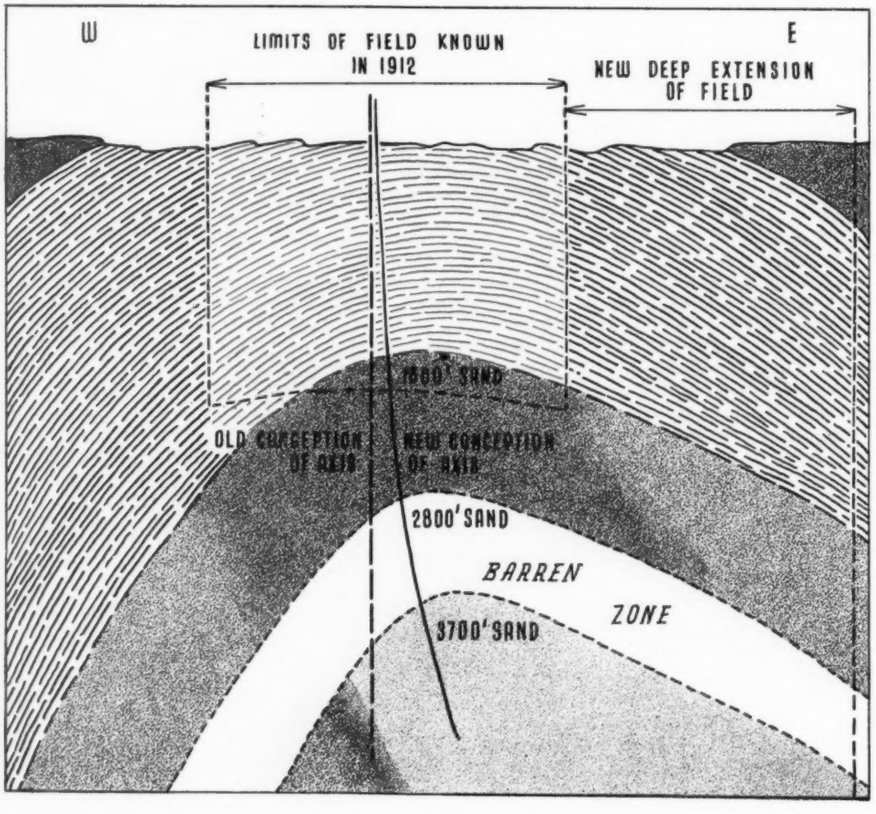
YENANGYAUNG is not only the best known of the Burmese fields but it has



A section across the Tertiary Trough of Burma showing formations indicated by the map on page 582.



Above: View of a portion of the Yenangyaung field as it appears today. Below: A diagrammatic section across the Yenangyaung field, showing how the discovery of the asymmetry of the fold has affected the extent and life of the field (vertical and horizontal scales equal).



claims to be considered the most wonderful field in the world. There is some evidence that it was known and worked in the early thirteenth century. Before the advent of the Burmah Oil Company in 1886, large quantities of oil were won by the Burmans from hand-dug wells. For many years, even as late as 1910, over 5,000,000 gallons of oil were won annually in this way. The wells were really shafts, five ft. square, lined with planks and actually reached depths of over 400 ft. The well-digger was let down by a rope passing over a pulley and worked frantically for half a minute in the gas-laden atmosphere before being hauled to the surface for a prolonged rest. Even at the present day a few hand-dug wells survive amidst the forest of derricks. The oil is hauled up by a few coolies running down an incline suitably placed from the well and pulling with them a rope over the pulley. The oil so obtained is sold to the Burmah Oil Company. Such methods of oil-winning are archaic and laborious in the extreme. In the past at least one noteworthy labor-saving device, resulting in a very marked increase in yield, has been tried. That is the construction of a side-gallery from the hand-dug well to the carefully bored pipe of a near-by tube well, unbeknown of course to the owner of the latter.

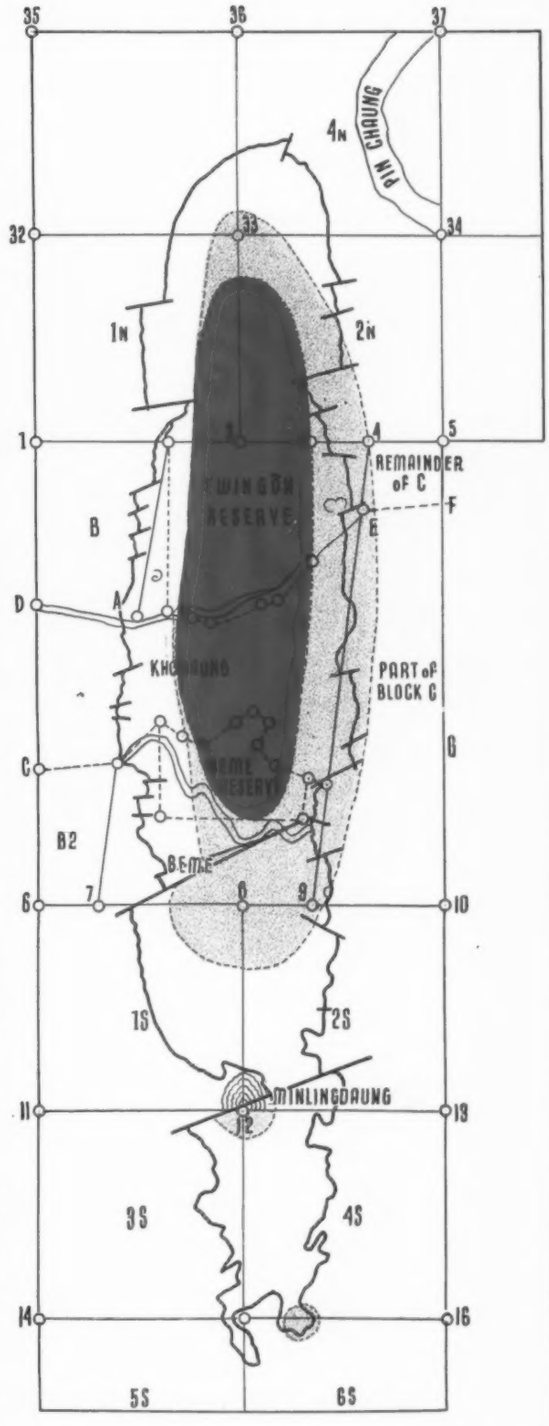
During the Burmese régime two petroliferous tracts—Bemè and Twingôn—

were worked and the right to mine was granted to 24 heads of families known as twinzayos. A twinzayo could allot sites to any member of his family, but could sell his right only with the consent of the whole body of owners. When Upper Burma was annexed in 1885, the rights of the twinzayos were recognized. The Twingôn and Bemè reserves were demarcated, the former containing 295 acres, the latter 155 acres. By fixing the minimum distance between wells at 60 ft., over 4,000 well sites were determined. The wells belonging to King Mindôn, which he acquired by marriage with a female twinzayo or by mortgage, and 27 wells whose owners could not be found, fell to the Crown, and these 164 State wells were leased to the Burmah Oil Company. The Burmah Oil Company was formed in 1886, though their managing agents, Messrs. Finlay, Fleming and Co., had previously traded in oil at Yenangyaung. The first well was commenced in 1887 in Khodaung, but it was not until 1906 that a second producing company appeared. The whole of the production from machine-bored wells between 1888 and 1906 inclusive was that of the Burmah Oil Company. In the interval, however, the Burma Oil Syndicate had drilled unsuccessfully in the south (blocks 1S and 2S) in 1890, and a subsidiary of the Standard Oil Company made an unsuccessful attempt to enter the field in 1901. Late in 1906 the Rangoon Oil Co. (now a subsidiary of the British Burmah Petroleum Co., Ltd.) began to lease wells from the twinzayos and commenced drilling and production in 1907. Very soon the competition to secure well sites from the twinzayos in the Bemè and Twingôn reserves became very fierce. It is only in these reserves that competitive drilling is possible; the remainder of the oilfield, or at least Khodaung and blocks 1N and 2N, is leased to the Burmah Oil Co. The price asked by the twinzayos for their well sites rose rapidly from Rs. 20 to Rs. 100 in 1895 to Rs. 5,000 in January, 1907, and to Rs. 50,000 ($17,000) in 1910. There are now practically no well sites of value available. In April, 1907, drilling was commenced by Messrs. Jamal Brothers and Company—whose oil interests were afterwards merged with those of Messrs. Steel Brothers and Co., as the Indo-Burma Petroleum Co., Ltd. (I.B.P.). Messrs. Steel Brothers and Co., Ltd., remain the managing agents of this prosperous oil company as well as of the Attock Oil Co., Ltd., which operates in the Punjab. The Nathsingh Oil Company was floated in April, 1908; the British Burmah Petroleum Co., Ltd. (B.B.P.), at a later date, (1910). It is unnecessary to more than mention such short-lived companies as the Twinza Oil Co. (T.O.C.), United Twinyo, Aungban Oil Company, and Anglo-Burman Oil Co., but of greater vitality is the Yomah Oil Company, Ltd. (1920).

The oil of Yenangyaung is sent to Rangoon for refining. The Burmah Oil Company have a 10-inch pipeline, 300 miles long, from Yenangyaung to their refineries at Syriam on the Rangoon River. The Indo-Burma Petroleum Co. send their oil by barge or oil flats to their refinery, also at Syriam, lower down the Rangoon River. Geologically, Yenangyaung is a fine elongated dome with gentle dips of about 25 deg. on either flank and a gentle pitch to the north northwest and the south southeast. In 1912 when Sir Edwin Pascoe wrote his famous account of the field, the total known area was less than 1,000 acres and the deepest oil sand was the 1,800 ft. sand. In later years sands down to 2,800 ft. on the crest (and to correspondingly greater depths on the flanks) were proved and exploited. At greater depths—down to 3,700 ft.—only gas and water sands were found, until the important discovery was made, by the geological staff of the B.O.C. in 1926, that the fold was not symmetrical but slightly asymmetrical, with gentler dips to the east.

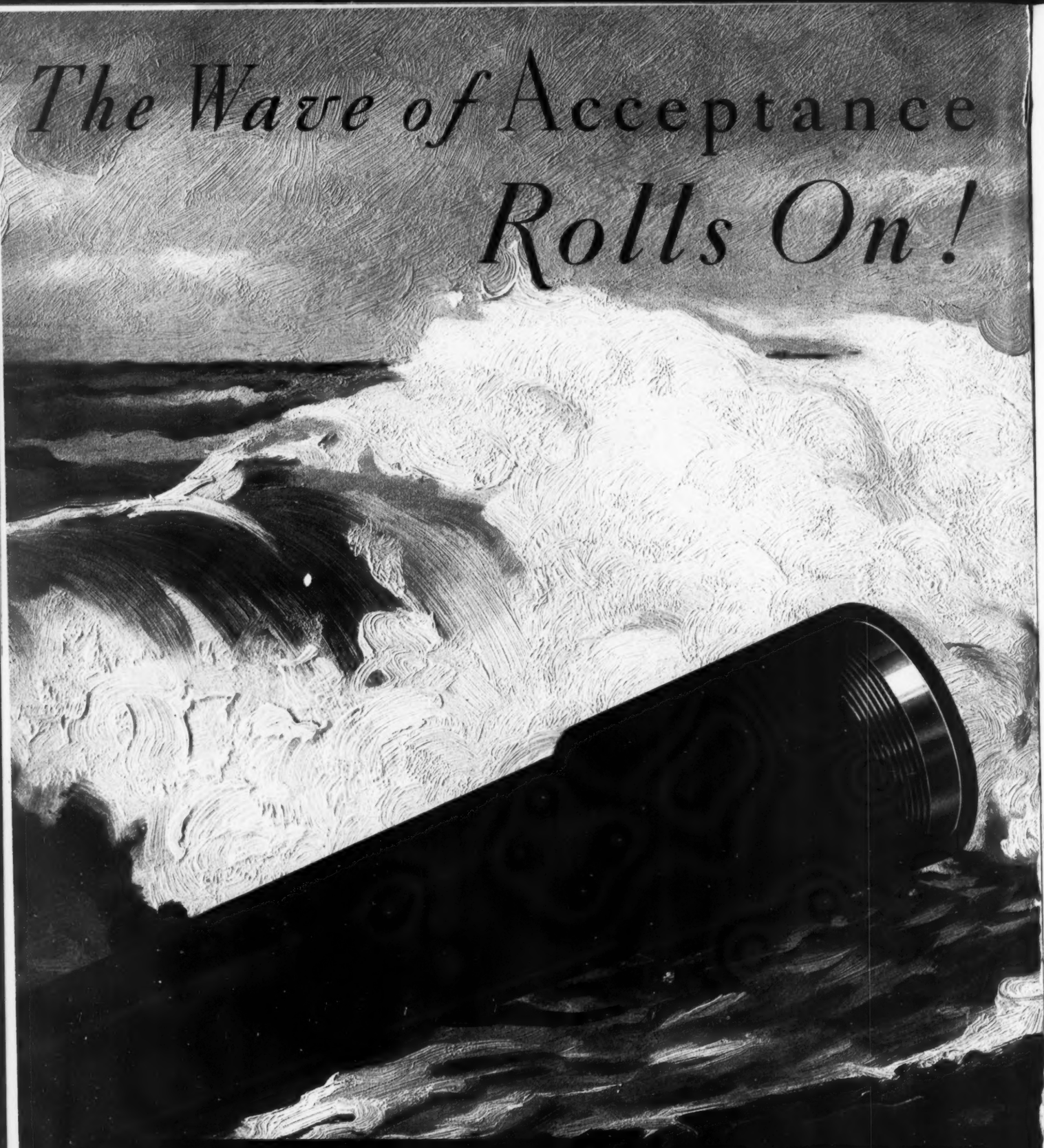
The deep sands are now known to be productive down the eastern limb and the proved area of the field has been doubled since 1926. From the original area of 1,000 acres, approximately 4,000,000,000 imperial gallons of oil have been obtained, the new known resources contain certainly sufficient oil to maintain the prosperity of the field for many years to come. The amazing richness of the field is due in a large part to the large gathering ground; its continued prosperity is the result of careful organization. Despite the existence of over 3,000 producing wells there is no wasteful competition; the whole field is electrically operated, the utmost care is taken to protect the oil-sands against flooding by water, and the conservation of the gas pressures is a matter of first consideration. In the reserves with their closely spaced competitive wells, vacuum (to a degree determined upon by the operating companies) is applied, while back pressures are applied to youthful wells. In the large blocks leased by the B.O.C., gas drives are used and gas is also injected both for storage and repressuring. As a result of the new knowledge of the structure, the deeper sands mentioned above as being gas or water sands below the superficial crest, have been found to be oil-bearing at depths up to 5,000 ft. on the eastern flanks.

The Yenangyaung dome is crossed by numerous dip or transverse faults. The fault planes are often filled by mud (mud



The Yenangyaung field (scale: one inch=one mile). The black line shows the approximate boundary of the Peguan. The solid red area shows the extent of the field as known in 1916, the area from which the bulk of the production has taken place. The light red area shows the present (1936) proven extent of the field.

The Wave of Acceptance Rolls On!



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veins) and many of the oil sands have thus been effectively sealed. This accounts for the varying yield of wells often only a few yards apart. Still more important, it is believed that separate oil pools beyond the present southern limits of the field remain to be detected and exploited. In 1930 oil was struck at 4,100 ft. south of the Minlindaung fault; in 1931 a small production was obtained from 5,000 ft. a mile farther south. Block 4S has become this year one of the chief reserves of the B.B.P. and competitive drilling has been carried out by the B.O.C. These new developments indicate the continued long life of the field—particularly in the areas leased by the B.O.C. Apart, too, from the use already made of the gas, vast resources remain to be used in other ways.

Production in the field was allowed to reach a maximum of 240,000,000 gallons in 1916; for the past ten years it has been steadily maintained between 130,000,000 and 140,000,000 gallons.

Singu

THE Singu and Yenangyat fields lie along an asymmetric fold of Peguan rocks, the axis of the fold running N.N.W. to S.S.E. along a line which would pass, if prolonged, about eight miles to the east of the Yenangyaung fold. The exposed inlier of Peguan rocks is about 39 miles long; towards the southern end the field is cut obliquely by the Irrawaddy River; south of the river is the Singu field; north of the river the Lanywa, Yenangyat and Sabè fields. Dr. Thomas Oldham suggested after his visit in 1885 that the oil of the Yenangyat Hills might be worth exploitation and native wells were started some years later, but it was not until 1897 that G. E. Grimes examined the Singu area and recognized its possibilities.

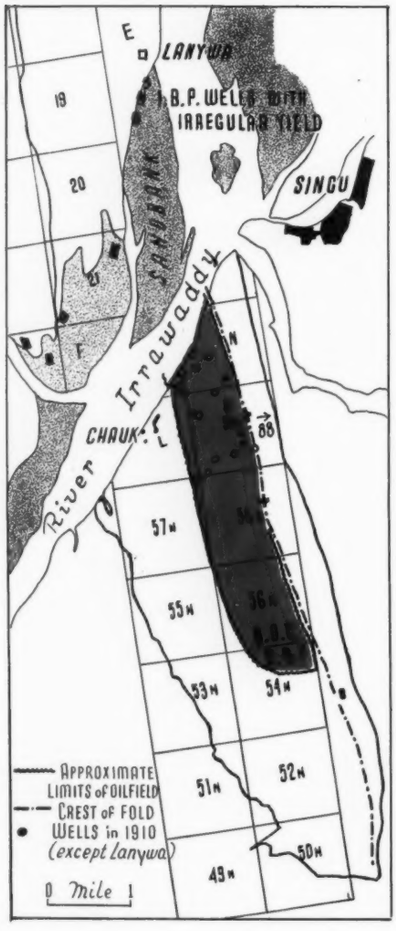
The most valuable part of the whole Singu-Yenangyat area is the southern end —the Singu field. The greater part of the Singu field is leased to the B.O.C., and has been steadily and carefully developed. In reserves it probably ranks above Yenangyaung but at present is used by the B.O.C. to supplement Yenangyaung production as may be required by the Syriam refineries. Thus in 1916 (Yenangyaung's maximum year) Singu produced only 44,000,000 gallons against 86,000,000 the next year In the last 10 years the production has been between 80,000,000 and 100,000,000 gallons. This production includes that of the British Burmah Petroleum Co., Ltd. The Rangoon Oil Co. took up blocks in the south despised by the Burmah Oil Co. because they were some distance down the somewhat steep (8 to 20 deg.) southerly pitch, and were rewarded by an important share in a very rich field. This area is now a valuable reserve of the British Burmah Petroleum Co., Ltd. The B.B.P. wells have an average depth of 3,000–3,500 ft. Along the northern end of the block—54N —the B.O.C. have practiced offsetting to some extent. It is interesting to note the depth at which the B.B.P. get their best production—over 3,000 ft. Down to about 2,800 ft. there is a great deal of water which has to be shut off; the oil sands are below. Hence this southern extension of the field was only located by deep tests, after passing through unpromising water sands. Still farther south the structure is crossed by a fault near the borders of blocks 52N and 50N. This holds up a rich pool, recently discovered and worked jointly by the B.B.P. and I.B.P. The B.O.C. (through the Moolla Oil Co.) owns a tract in the eastern part of the new field.

The Singu oilfield is abruptly truncated by the Irrawaddy River and a number of the Burmah Oil Co.'s wells are actually on the river foreshore and surrounded by the swirling waters of the river during the high-water season. The photograph on page 581 shows one of these wells and illustrates the use made of old pipes in constructing a pier on which the rig can be built. Following the success of the embankment on the opposite shore at Lanywa, the B.O.C. commenced in 1933 the construction of a wall to enclose this foreshore area.

A photograph taken by Dr. Stamp showing the famous mud volcanoes at Minbu.

Lanywa

ONE of the most interesting oilfields of Burma is undoubtedly that to which the name Lanywa is now given. Lanywa is a small Burmese village on the banks of the Irrawaddy where that river sweeps from N.E. to S.W. obliquely across the



The Singu-Lanywa field, 1910–1925, before reclamation of sandbank.

great N.S. fold of Pegu rocks containing the Singu and Yenangyat oilfields. It was undoubtedly certain that the rich Singu oilsands must stretch a considerable distance under the Irrawaddy. The obvious question of importance was—how far? A glance at the sketch map above shows that at this point the change in direction of the River Irrawaddy causes the main stream of the river to hug the Singu shore and to form, as has been already pointed out, a serious menace to the B.O.C. wells situated along the shore. As a further consequence a huge sandbank formed along the opposite shore, a sandbank comparatively permanent in its position and only covered by water for two or three months of the high-water season. In order to ascertain with certainty the northern extent of the Singu oilsand, it is obvious that a well placed near the southeastern margin of the sandbank would almost certainly be a productive well and might easily prove a big producer. Consequently, the Indo-Burma Petroleum Co. attempted to put down a test well in this position during the few months available between one high water and the next. Ill-luck dogged the attempt, the imminent rise of the river level necessitated the abandonment of the test before it had proved anything definite. In the haste of removal the pipe was left in the hole and in the high-water season an Irrawaddy Flotilla steamer ran afoul of the obstruction. Most travelers up and down the river must have heard the story, which loses nothing in the telling. The accident prevented any similar attempts being made and resulted in the Irrawaddy Flotilla Co. having a considerable say in the development programs in the future. An important point which could be settled was whether or not the Singu oilsands extended as far north as the Lanywa shore. Four wells were put down; three struck oil but a middle one did not and the yield of the others was limited. The company determined to risk £100,000 (the eventual cost was much greater) and enclosed the sandbank by a wall. The work was carried out in three stages—1925–26, 1926–27, 1927–28. The construction of the wall was facilitated by the occurrence of reefs of hard rock jutting out from the shore in just the direction it was desired the wall should commence, and quantities of stone and rubble were available from other hard bands in the Peguan rocks. The massive revetted embankment is protected by an apron and is nearly two miles long and is to be further extended in the season 1936–37. The first well in the reclaimed land was commenced in 1927. By the end of 1933, 50 productive wells had been drilled and 110,000,000 gallons of oil obtained. The years 1934 and 1935 each showed a 10 percent increase. This model field is, of course, exploited exclusively by the I.B.P. Good oilsands are found at 1,700, 1,900 and 2,500 ft. Gas from the oilsands (there are also separate gas sands) is first sent for gasoline extraction at the company's plant which recovers approximately one gallon of gasoline per 1,000 cubic ft. of gas. The residual dry gas is used to generate power at a central station (from which most wells are electrically pumped) and is also used in the machine shops. Back pressures are applied at most wells. With an annual production nearing 30,000,000 gallons this field has good prospects. Obviously a future problem to be solved is the recovery of the oil which exists below the actual bed of the great Irrawaddy.

Yenangyat and Sabè

THE Yenangyat fold gives rise to a long line of barren but picturesque hills forming the right bank of the Irrawaddy for many miles. They were visited by Dr. Thomas Oldham in 1855 and he suggested that the oil might be worth exploitation. Burmese hand-dug wells were commenced a few years later. The B.O.C. first commenced operations around Yenangyat village in 1891, and oil production is officially recorded for the first time in 1893. Later in the field were the Rangoon Oil Company (B.B.P.) and Minbu Oil Company. It was gradually found that the commercially valuable field was restricted to the crest maximum of the fold which is attained in blocks 8 and 9. Of the valuable area the B.O.C. held blocks 7, 9, 12; the Rangoon Oil Co. blocks 8, 13 and B and C; the Minbu Oil Co. blocks 10 and 33. Many of the wells gave a high initial yield—as much as 30,000 gallons in the first 24 hours, but the yield dropped rapidly just as that of the field as a whole has done. The Yenangyat and, to some extent, the Singu oils are richer in the lighter hydrocarbons than are the Yenangyaung oils. The B.O.C. oil is sent to Singu by means of a 4-inch pipeline, Singu being connected with Yenangyaung by an 8-inch line.

There are really two reasons for the poverty of Yenangyat when compared with Singu. One is that only the lower horizons of Singu are still present unexposed at Yenangyat, the other is the gradual tendency of the Peguan rocks to become more sandy and continental in nature when traced northwards—evidence that they were laid down under conditions less suitable for the formation of oil.

In the northern part of the Singu-Yenangyat fold there is another crest maximum west of the village of Sabè, in blocks 57, 60 and 67. The B.O.C., R.O.C., and M.O.C. were all interested in the field, but a few initial high yields rapidly declined, heavy gas was encountered, and this is one of the regions of Burma which has been troubled by a yield of emulsion. The field has never been important; its small production, which was first recorded for 1907, is included in the official figures for Yenangyat. Though structurally distinct, the fields of Lanywa, Yenangyat and Sabè all lie in the Pakokku district, and their productions are not, therefore, separately recorded in government returns.

Yenangyat reached its maximum production of nearly 23,000,000 gallons in 1903; the total (including Sabè) dropped to under 2,000,000 gallons in the years

1923 to 1937. In 1931 a 3,500-ft. sand was discovered at Yenangyat (below 2,000 ft. of barren rocks) and much drilling activity in 1934 and 1935 has led to an increased yield. The field has large gas resources not yet used.

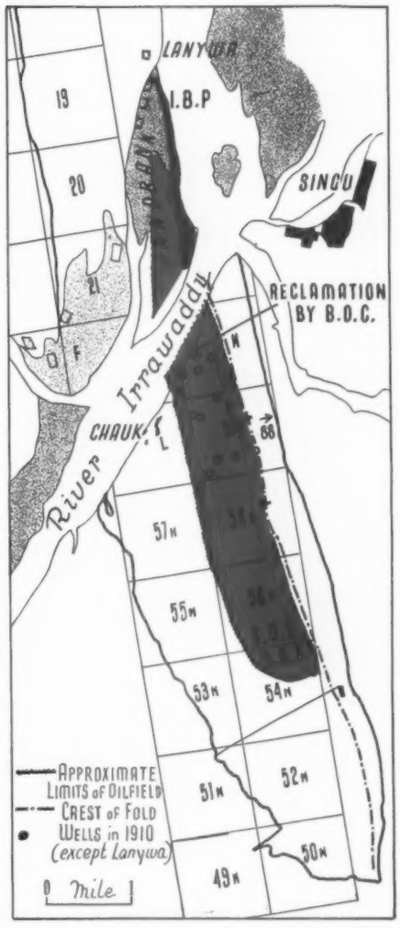
Minbu, Palanyôn and Yethaya

THE whole Minbu fold resembles the Singu-Yenangyat fold in that it is a long asymmetric anticline of Peguan rocks with a north-south trend—about 20 miles in length. Along the fold are three oilfields—one, Minbu proper, is at the northern end and occupies a curious position some distance down the pitch; a second, corresponding to a crest maximum near the village of Palanyôn; a third, corresponding to another crest maximum southwest of the village of Yethaya.

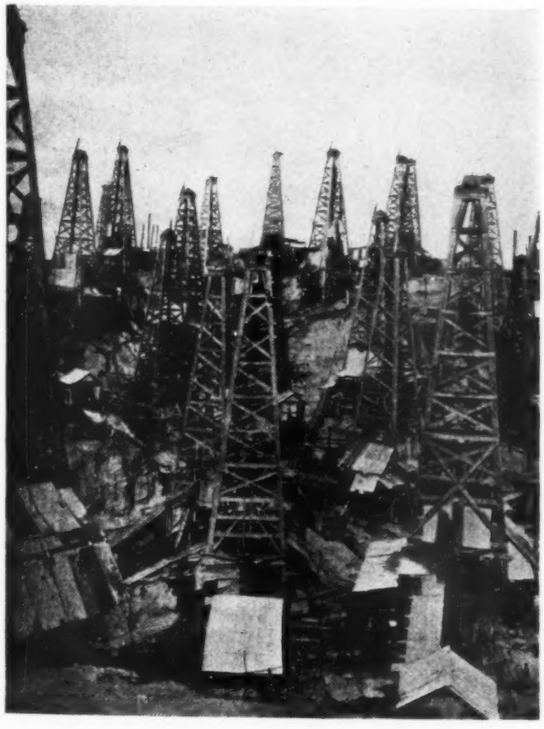
In the description of Yenangyat, two reasons were given for the increasing poverty of the Peguan when traced northwards. In the case of the Minbu fold there are three main reasons for its poverty when compared with Yenangyaung to the north. The first is the lithological change in the rocks—the marked increase in the proportion of clay laid down in deeper water and less suitable for the formation or retention of oil, a change still more marked in the Thayetmyo district farther south. The second is the same as that given in the case of Yenangyat—the greater thickness of Peguan exposed and the fact that many of the higher petroliferous horizons have been denuded away. The third is the more intense folding—the rocks are frequently vertical and even overfolded on the eastern limb. The total production of the three fields (largely in the hands of the B.O.C.) is maintained at between 3,000,000 and 4,000,000 gallons.

Indaw

INDAW, the northernmost field of Burma, was discovered by the geologists of the Indo-Burma Petroleum Co. Ltd., and production is first recorded officially for 1918. There is no doubt that the discovery caused considerable surprise. Indeed, when experimental drilling was commenced it is said that a well-known geologist volunteered to drink every drop of oil which would be obtained. His dose to date would be nearly 40,000,000 gallons. The reason for this skepticism is not difficult to understand. That the Yenangyaung and Singu oil horizons rapidly became poorer northwards when traced through the Yenangyat fold was already known, and, if this change persisted, it seemed impossible that a field could be found in Peguan rocks so far north—175 miles north of Yenangyat.



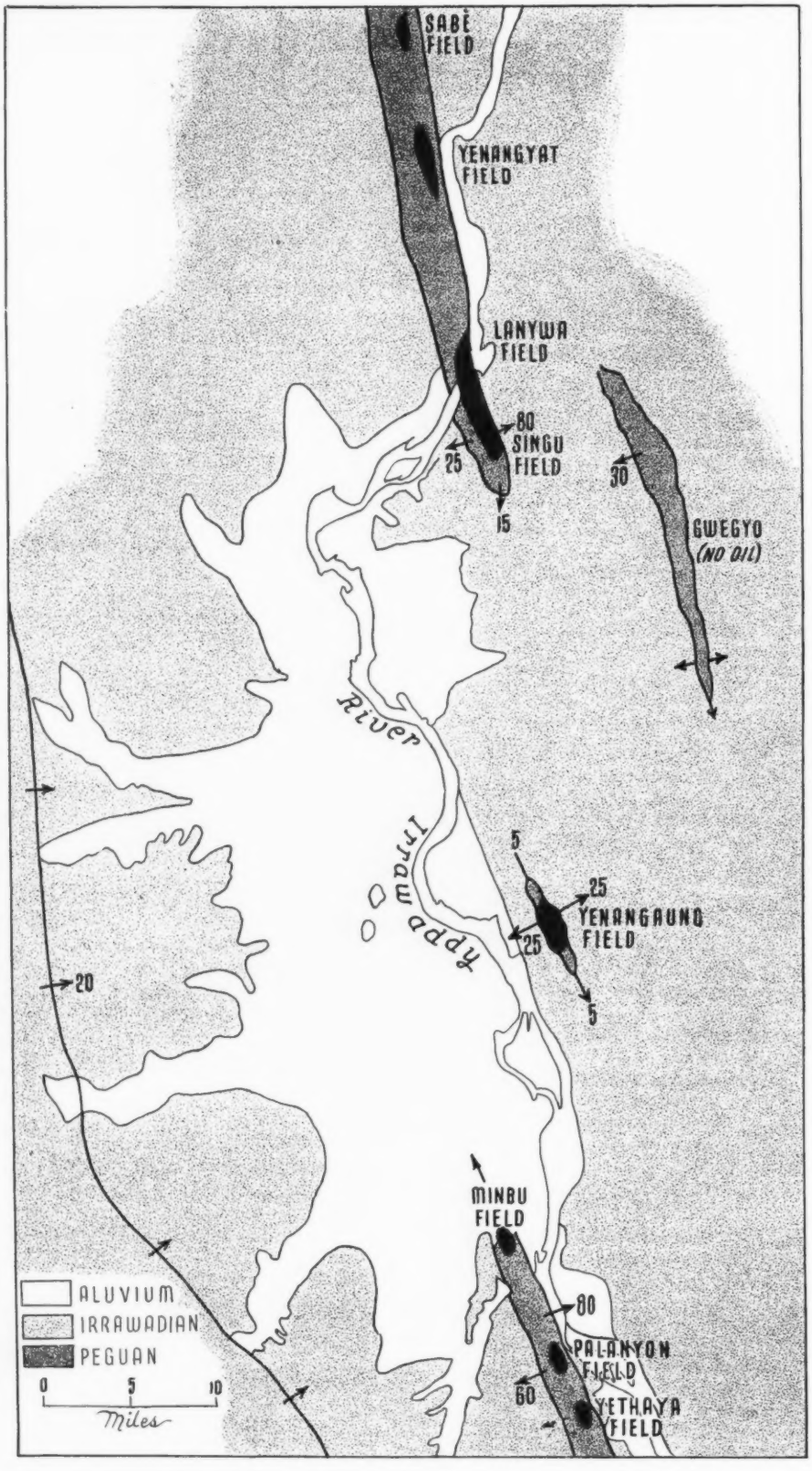
The Singu-Lanywa field in 1936, after reclamation of sandbank.



The Bemè Reserve of Yenangyaung showing competitive drilling as long ago as 1922.

Structurally Indaw is a fine, gently folded, open dome, and the field has possibilities since production up to the present has been from shallow sands. Deep testing has been hindered by drilling difficulties and heavy gas. Indaw is situated in the wet zone of Upper Burma, north of the dry belt, and health conditions have caused much trouble, but active measures have been taken to combat fever.

The company has followed the policy of steady development and the majority of the wells are now operated by an automatic gas-lift; the oil is sent by pipeline and refined at Pantha (22 miles distant) on the River Chindwin, whence it is sent down the river and supplies the local



The chief oilfields of Burma, showing the importance of central position and gathering grounds.

markets of Upper Burma—the chief product being kerosene for burning. One of the local difficulties is the shipment of the oil in the low-water season when the Chindwin becomes very shallow. The large flat-bottomed stern-wheelers of the Irrawaddy Flotilla Company draw only 18 inches when fully laden, but even then often spend days on sandbanks. Production at Indaw is being maintained at between 3,000,000 and 4,000,000 gallons.

Yenanma and Padaukpin

YENANMA is a remarkable little field which stands alone among the Burmese fields. It seems, on superficial examination, to consist of a pocket of oil-bearing sands situated in the midst of a group of laminated sands and clays forming a homocline (or monocline) with a steady easterly dip of 20 to 25 deg. The field, together with the small dome of Padaukpin, was exploited by the Indo-Burma Oilfields Ltd. (1920), and in the first year of production over 2,000,000 gallons were obtained. The production from the two fields has been under a million gallons for the last eight years.

THE small yield from the Kyaukpyu and Akyab districts has now become negligible. Despite a large number of tests all over the country and much detailed geological investigation, no new fields have been discovered and the possibility of any considerable field being detected has now become very slight. The country has, however, extensive natural gas resources of which little use is made at present. The Pyaye gas-well, for example, on a structure investigated by the writer for the I.B.P., yielded between 30,000,000 and 40,000,000 cubic ft. per day for several months before it was successfully closed in. The gas is now being used as fuel in a cement factory.

Summary and Conclusions

THE oil industry in Burma is well organized and the fields are models of efficient exploitation. The policy is to maintain the present output and, unless some change in policy becomes desirable, it is probable that the output 20 years hence will be approximately what it is today. It is true that the output of India including Burma reached record levels in 1934 and 1935, but the totals were only a few percent above those of 1919 or 1921. At the same time there is now little possibility of the discovery of new fields but the gas resources of the country remain to be utilized more fully.

Sir Henri Deterding Succeeded By J. E. F. de Kok

SIR HENRI DETERDING'S resignation from his post as general managing director of the Royal Dutch-Shell group, which was announced on October 23rd, was an outstanding news event of the month, both because of his official position and because of his personal influence upon the course of petroleum affairs.

Sir Henri steps aside . . . .

Rumors of his impending retirement have been heard at various times and it was known to his personal friends that he had offered his resignation on several occasions, but his associates previously had persuaded him not to take the step. Earlier in the year he had celebrated his seventieth birthday anniversary and the completion of forty years of service to the Royal Dutch Company. With the company itself established in a position of impregnable strength and with the outlook for the petroleum industry better than it has been for many years, Sir Henri felt that there was no longer any serious impediment to his retirement and insisted upon relinquishing the active direction of the company's affairs.

While giving up his post as chief executive Sir Henri retains an active connection with the company through membership of the Board of Commissaries. For the information of those not familiar with the corporate laws of Holland, it may be explained that the board of commissaries of a Dutch company corresponds generally to the board of directors of a British or American corporation, except that the commissaries exercise only such powers as are conferred on them by the articles of association or by-laws of the company. All other authority is in the hands of one or more directors. Where there is a single managing director his position corresponds to that of chairman in Great Britain or president in the United States, but under the practice prevailing in the Netherlands there may be two or more joint managers sharing executive authority.

J. E. F. de Kok becomes Royal Dutch-Shell's new general managing-director . . . .

As successor to Sir Henri Deterding in the position of general managing director of the Royal Dutch-Shell group, J. E. F. de Kok, formerly joint managing director, has been selected. Mr. de Kok, after early service as an army officer, joined the Royal Dutch forces in 1908 as a chemical engineer. He rose through various positions in the engineering and refining divisions of the company and became a managing director in 1921. Since that time he has been at the head of the company's organization at The Hague and it is understood that he will continue to make his headquarters there.

Associated with Mr. de Kok as his chief lieutenants will be three managing directors. Of these J. B. Aug. Kessler, whose headquarters are in London, has served in this capacity for several years. Newly appointed managing directors are J. C. van Eck, chairman of the Shell-Union Oil Company, and J. M. de Booy, who has been for the past few years assistant manager at The Hague.

Mr. van Eck's appointment is noteworthy since it will place among the directing officials of the group a man who is thoroughly familiar with conditions in the American field which now occupies a very important place in the operations of the Royal Dutch-Shell. For the past twenty-five years Mr. van Eck has been connected in one executive capacity or another with the Shell companies in the United States, and has had an important part in building them up to their present position as country-wide operators and distributors.

and J. C. van Eck joins the triumvirate of managing-directors.

After studying for the law and graduating from the University of Utrecht, Mr. van Eck joined the Royal Dutch Com-

(Continued on page 612)

Devaluation Encouraging to World Oil Trade

Benefits to International Petroleum Trade Likely to be Gradual. Production and Treating Costs in Dutch Colonies Being Brought into Line with World Costs.

By Alec H. Day

RECENT currency devaluation in Europe, and the disappearance of the "gold bloc," are certain to have wide repercussions on international oil trade. It is as yet too early to fix the precise spot in which the major economic changes will occur, or to assess their ultimate effect; but on present indications, the first advantage for petroleum will be increased turnover, resulting from a general improvement in world trade. Any advantage which may be gained by oil profit margins seems likely to follow rather than precede an improvement in world consumption.

As a factor in refining and production costs, the most important devaluation measure was the relinquishment of the gold standard in Holland. Dutch guilders have been left to find their own exchange level, without the fixing of a new nominal parity or the stabilizing effect of gold movements. The ultimate figure at which Dutch exchange is to stabilize itself has therefore still to be determined.

Depreciation to date has nevertheless been sufficient to provide a distinct advantage to oil operators in the Dutch Colonial possessions. This advantage should come from a reduction in production costs in Netherland India and refining costs in the Netherlands West Indies.

Such reduction in costs occurred when the guilder value of petroleum and products shipped from Dutch colonies increased (as a result of the decrease in the value of the guilder measured in pounds or dollars) whereas fixed costs, such as interest on invested capital, amortization, etc., measured in guilders, remained the same. The cost of labor, measured in guilders, also will remain at the same level or, at most, will increase very gradually. At the same time that element in the cost of production represented by the value of imported material, such as American drilling and refining equipment, increased in the same proportion as the increase in revenue derived from exports. But in view of the fact that interest, amortization, labor, etc., represent by far the larger share of the cost of production, producing and refining companies in Dutch colonies will benefit. There is, however, no reason to suppose that the benefits of devaluation in these areas will have any serious effect on world competition.

Both these fields have operated at an exchange disadvantage since the exchange values of the United States dollar and the pound sterling were reduced in 1933 and 1931 respectively. A fall in the guilder does nothing more than relieve the companies engaged in Dutch colonial oil trade from an incubus of some years standing.

Moreover, devaluation can only operate to the advantage of producing and refining concerns in Dutch territory to the extent that it is not offset by a rise in local operating costs. The usual corollary of a decline in external currency value is a rising trend in wages and other domestic outgoings, and unless effective measures are taken in Dutch colonies to keep such expenditure in check, oil companies operating there may be little better off under devaluation than they were under the deflationary policy previously followed in Holland. Any change for the better in their position is more likely to be reflected in a slight improvement in profit margins than in a fall in export prices, and there is thus little ground for anticipating pressure on Gulf prices through the reduction of refining costs in Curaçao and Aruba.

Devaluation in Europe has little effect on Roumanian export prices, since Roumanian currency is not directly affected, and export quotations in Roumania have for a long time past been quoted in "gold sterling," an expedient adopted to protect exporters against currency fluctuations. Recent currency changes have of course involved Roumanian exporters in finding a new method of calculating gold sterling. This relation between sterling and gold was formerly fixed on the basis of the London-Paris exchange. It is now reached by relating the price of gold when Britain was on the gold standard to the current price of the metal in London. Since the London price for gold is now determined by the level of the New York exchange, the latest method of the Roumanian export trade for fixing selling prices is in reality based on the dollar, although quotations are made in "gold sterling."

It may be taken for granted that oil producing countries will be less affected by devaluation than consuming countries, which should feel the first direct results of the new exchange values. Governments in all consuming countries realize that the success of currency devaluation depends mainly on preventing a rise in the internal price level, and plans are already afoot to keep internal prices down as far as possible. Petroleum products, with their important influence on general costs in any modern community, are naturally among the first to receive official attention.

France, having roughly fixed the level of her exchanges, has issued a decree laying down cuts in duties on imports. Reductions range from 20 percent on raw materials, to 15 percent on finished products. The decline in the exchange value of the franc, owing to devaluation, was approximately 30 percent, and according to the PETROLEUM PRESS SERVICE, London, the resulting rise in the import price of motor spirit in France was about 10 francs per hectolitre, while the total duty reduction amounts to only 8.50 francs per hectolitre. The duty reduction, therefore, does not completely balance for the rise in import prices. In the case of motor spirit, the French industry will be faced with the alternatives of higher selling prices or reduced gross profits on an already unremunerative market. On this subject, the French government, having power to fix prices under certain conditions, will probably have the last word, but a constructive measure would have been a more generous cut in duties, giving industry a good start in its operations under the new conditions.

Although not directly concerned in devaluation, the British market has not entirely escaped reactions from the new currency alignment. Following the announcement, concurrently with devaluation in France, of the new currency stabi-

lisation agreement between that country, Britain and the United States, sterling has fallen rapidly in terms of dollars. The result has been a rise in the sterling equivalent of Gulf oil quotations. The London-New York exchange, which fluctuated around 5.05 dollars to the pound during the greater part of September has since been below 4.90 and is expected by many observers to stabilize finally around the old parity of 4.86⅔. This advance in the dollar, and the consequent rise in British costs of imports from the Gulf, however, has done little more than offset the decline in tanker freights since the beginning of the current year. In Britain, as in other markets, the collapse of the "gold bloc" is likely to produce only a limited disturbance to oil price levels.

Far more important than the immediate price reaction to devaluation is the prospect which the new currency conditions hold out of a substantial reduction in present impediments to world trade. By coming to an arrangement to keep their currencies mutually stable, France, the United States and Britain have made a major contribution towards the relaxation of trade restrictions. This development has met with a promising reception throughout the world, and signs are already appearing that the lead towards economic sanity is being followed. Danger seems now to lie rather in an exaggeration of the possibilities of a quick return to more normal international trade and an under-estimate of the difficulties to be faced.

Even the three-power agreement will present some stiff problems. Actual budget deficits in the United States and France, and the prospect of a revenue shortage in Britain at the close of the current year, suggest only one aspect of the adjustments which may have to be met in view of the reactions of internal conditions on exchange rates.

The movement towards cutting away world trade restrictions will similarly be beset with difficulties. Most countries have now adjusted their economy to a basis of import duties and restrictions, exchange control, clearing agreements, and other impedimenta of acute trade depression. For unravelling the tangle into which world trade has thus been tied an immense amount of time and trouble will be necessary, and the liberation of trade will be correspondingly slow and painful.

Realization of these difficulties should not obscure the very substantial benefits which should ultimately accrue from the wider commercial intercourse which has now become a distinct possibility. Owing to the operation of big integrated groups in world oil trade, this section of commerce should enjoy some of the earliest benefits from the breaking down of trade barriers. The international oil groups, for example, have been hindered severely in manipulating their oil resource to the best advantage by the knowledge that funds cannot be withdrawn freely from certain countries. Any effective reduction in exchange restrictions would be an inestimable advantage to these undertakings.

It may also be taken for granted that, with greater freedom in world commerce, the consumption of oil products would advance rapidly. Up to the present, any general economic recovery which has been achieved has been limited both in volume and extent, yet the consumption of petroleum has received a definite stimulus. With progress towards recovery on a wider and more substantial scale, the world demand for petroleum may be expected to advance much more rapidly, especially in those countries of the former "gold bloc," such as France and Holland, where motor transport and the use of motor spirit has been restrained by economic depression and high taxes.

While, therefore, the oil industry should not expect too much from the new currency order which has been established, there are good grounds for anticipating great advantages in course of time, although they may only accrue gradually.

The three-power currency agreement has stirred world trade opinion sufficiently to have created a considerable measure of confidence, and this in itself should give the first stimulus to further commercial recovery. If, through greater confidence and the relaxation of restrictions, international commerce can stage a revival, oil will evidently be among the first industries to benefit.

The railroad station at Baku where oil workers are constantly arriving and leaving, the unique labor turnover proving one of the major handicaps of oilfield management in the Soviet Union.

© Sovfoto

Blow-out at Talara

Early in February of this year well No. 2810 at Talara, Peru, blew out, wrecked the rig and ran wild for 10 days. Miss E. Phyllis Snyder of New York happened to be in the vicinity making a photographic survey of oilfield development in South America. Day by day she was able to obtain this vivid record of the conquest of a wild well under heavy pressure by a skilled oilfield crew.

1. Well No. 2810 blows out from 1300 ft.—and men rush to start the job of getting it under control again.

2. Preparing the sandbags.

3. Workmen assembled at the well—the start of a struggle that was to last 10 days.

4. A close-up of the blow-out—with sandbags ready in the background.

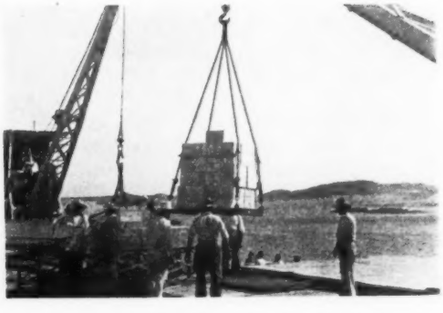
5. Working on the well. Notice the rigging in the background which has been blown away.

6. Arthur Iddings, head of International Oil Company's operations at Talara, leaves the scene for a short rest.

7. Still working—but beginning to get results.

8. Capped at last, after losing 500,000,000 cu. ft. of gas.

9. Mr. Iddings talking it over with his field superintendent after 10 days of almost continuous battling with the blow-out.



10. Normal operations resumed at Talara—five-gallon tins of gasoline being loaded for shipment.

Can This Be True?

WRITING on the subject of the Birth Control Industry in the November issue of THE AMERICAN MERCURY, Harrison Reeves, in dealing with the outlets for the sale of condoms says that these include "several thousand assorted gasoline filling stations, found on every street and highway in the nation. The exact number of these latter dispensaries is still a matter of academic dispute between manufacturers, jobbers, and the oil company executives, who have given the matter deep and restrained study. But despite the dispute on numbers, the filling station outlet is one of high importance, particularly in the South, where the sales traffic is thought to be due to the climate and the habit of evening driving, rather than to any emotional intensity or the great distance between drugstores. No oil company executive has as yet circularized his dealers, warning of sales practice, although it is generally disapproved for the same reason that selling liquor was frowned upon during Prohibition, *i.e.*, that bootlegging of any sort may lead to a feeling of irresponsibility toward the mother corporation, resulting in short changing and short gallons."

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Proration's Progress in Industry

CAN INDUSTRY GOVERN ITSELF?, by Dr. O. W. Willcox, 285 pp. Published 1936 by W. W. Norton, Inc. ($2.75)

One of the trends of the times is a steady increase in the extent to which industries are being put under control, regulation and direction, either to serve the purposes of the state or to protect their members from the effects of over-competition. In view of this expanding movement, exceptional interest attaches to the recently published work of Dr. O. W. Willcox entitled, CAN INDUSTRY GOVERN ITSELF?

The book deals primarily with the methods of regulation applied to sugar by ten leading and widely scattered countries, but it discusses the underlying principles on which such regimentation is based as well as the variations in detail due to local conditions. The same methods are applicable to all industries, and consequently the book is as instructive to the man who has to do with oil or cotton or coal as to the one whose primary concern is with sugar. There is a definite advantage in confining the subject matter to one industry because it avoids confusion and makes it possible to compare, on the simplest possible basis, the systems employed by each of the several countries discussed.

As Dr. Willcox points out, proration invariably begins in a saturated market where supply, whether wholly indigenous or partly imported, begins to outrun demand. It is then that prices fall to the point where destruction of capital is threatened and proration enters to stop this self-destructive tendency among producers, while at the same time protecting consumers from exploitation through too great an increase in prices.

The movement is designed essentially to preserve the *status quo*, to protect those who already have established their position by preventing an influx of new units and by preventing those already in the field from damaging their associates and themselves by increasing output beyond what the market can readily absorb.

As the author makes clear, the procedure is essentially the same whether under a democratic government or a dictatorship. It involves the limitation of output, the barring of new enterprise and some form of price regulation. It is a system of social economics as contrasted with the economics of free competition expounded by Adam Smith and his successors. It is an attempt to recognize and conserve human values and to make each controlled industry a factor of strength in the national social-economy.

While the author treats sympathetically these collectivist efforts to control industry, he does not attempt to judge between the two theories of economics which are everywhere in conflict. His great service is in pointing out which side is actually winning in what he calls "the pragmatic struggle between individualism and collectivism." His conclusion, fortified by a careful analysis of what is taking place in a great many countries, is that collectivism is triumphantly in the ascendant.

At a time when old ideas and ideals are being abandoned and new ones set up, this book is one that every business man should read carefully for the better understanding of what is going on around him and what changes are taking place in industry in the present period of confusion and transition.

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Holland S. Reavis

HOLLAND S. REAVIS, who founded the PETROLEUM REGISTER in 1917, committed suicide at Mount San Angelo, his Virginia home at Sweet Briar, in Ambrose County on October 26th. Mr. Reavis was said to be suffering from ill health at the time of his death.

Petroleum World Annual

PETROLEUM WORLD ANNUAL REVIEW, California Oil Industry. Published 1936 by Palmer Publications, Inc. 310 pp. ($2.00)

The 1936 edition of this well known annual review contains several important additions that have not appeared in previous issues. Moreover, the valuable statistical tables and records have been brought up to date, covering the whole of 1935.

Greater depths have developed a tendency toward heavier drilling equipment and have also served to focus attention on new methods and tools for both drilling and production. On this theme, Professor Lester C. Uren has developed a most comprehensive article on drilling and production equipment and methods, covering electrical coring, various forms of power, draw-works, rotary tables, mud pumps, drill pipe and bits, new control devices, pressure and directional drilling and a host of other problems encountered not only in California, but all over the world.

Statistical tables in the Annual give in detail the value and quantity of crude oil produced in California from the beginning of the industry to 1936, both the state total and production by fields. The quantity of petroleum and various products in storage on the Pacific Coast is set forth in another table, while still others give oil-well completions, daily output and dry hole records by fields from 1927 through 1935. A complete record of crude oil prices by fields is given. Perhaps the most interesting and unique record in this issue of the Annual is the dry hole record, giving the geological age, date when drilled, location, depth and formation at bottom for almost every dry hole in California. From year to year it is intended to add more information to this table, which even at present constitutes an extremely valuable reference work, unavailable from any other source. It is understood that the author spent several years gathering the information presented in this dry hole record.

Other tables in the book give the wells and production controlled by companies and the production record of every California operator for 1935.

This book contains a wealth of statistical, technical and review material on the California oil industry, unobtainable elsewhere, accurately compiled and conveniently arranged and indexed; a volume that is indispensable to the California oil man and useful to oil men everywhere.

Other articles in the book cover refinery construction in California, financial records and the profit outlook for 1937 and California's natural gasoline industry.

World Petroleum Abstracts

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry. *Edited by Dr. O. W. Willcox*

Petroleum Geology

USE OF INSOLUBLE RESIDUES FOR CORRELATION IN OKLAHOMA.—Hubert Andrew Ireland, in BULL. AM. ASSOC. PETROLEUM GEOLOGISTS, vol. 20 (1936), No. 9, pp. 1086–1121.

This paper shows the value of insoluble residues as an important supplement to the methods for determination and correlation of surface and subsurface strata. Beds similar in appearance and composition may be differentiated, a practical value in determining oil structures. A change in lithologic conditions is reflected by a change in residues. Many diagnostic characteristics such as arenaceous *Foraminifera*, silicified fossils, authigenic crystals, sand grains, types of chert, and other residues are liberated, concentrated, and exposed by the solution of the obscuring matrix. The pre-Mississippian formations of central and eastern Oklahoma, from the Arbuckle Mountains to the Ozarks, are correlated by means of residues of samples from wells and outcrops. The beds of the Simpson formation which change rapidly, both laterally and vertically, may be traced readily when studied according to zones instead of separate units. When lateral changes in the type of residue are noted, correlations may be extended for long distances, but not over long intervals between samples.

PRESENT TECTONIC STATE OF THE EARTH. —Hans Stille, in BULL. AM. ASSOC. PETROLEUM GEOLOGISTS, vol. 20 (1936), No. 7, pp. 849–880.

The present is the key to the past, but the past is generally believed to have been made up of relatively long and quiet epeirogenic periods separated by shorter times of orogenic disturbance. It is therefore important to decide whether the present is orogenic or non-orogenic.

In Central Europe, where the data are numerous, it can be shown that crustal movements of the present are perhaps ten times as great as those of the past, but the rate of movement is nevertheless small, and the comparison is less exact than could be wished.

The peri-Pacific region is in general better suited than Europe for a study of the problem, and California offers particular advantages. A compilation of the results of observations made by the writer and others in California shows that this region suffered a major orogenic disturbance in the Middle Pleistocene, at a time probably not more than 250,000 years ago. For this disturbance the writer proposes the name *Pasadenan orogeny*.

A study of this orogeny and of events following it suggests that, though its climax is long past, this disturbance has not yet completely died out. If this conclusion is warranted, the present does not truly reflect either the epeirogenic or the orogenic periods of the past, but is more disturbed than the one, and less disturbed than the climactic stages of the other.

OIL YIELDS OF TEXAS GULF COAST AND GERMAN SALT DOMES COMPARED.—A. Moos, in PETROLEUM, vol. 32 (1936), No. 27, pp. 1–5.

Gulf Coast oil fields are grouped in seven classes according to total production in tons, from 0 up to more than 5,000,000 tons. On the same classification basis the Wietze and Nienhagen fields in Germany would come in the second class (between 1,000,000 and 5,000,000 tons total), the Eddesse and Oberg fields in the fourth class (100,000 to 500,000 tons). On the whole, one average German salt dome yields about a fourth as much oil as an average Texas Gulf Coast field. However, there are only four known producing domes in Germany against more than 60 in Texas, and it is a fact that only five Texas domes produced more oil in 1935 than the Nienhagen field.

NOTE: The implication seems to be that if the number of salt domes were about equal, it would be found that the average yield would be about equal, irrespective of place of origin. ED.

Geophysics

PRINCIPLES AND PRACTICAL RESULTS OF GEOPHYSICS.—Anon, in PETROLEUM TIMES, vol. 36 (1936), No. 916, 48 pages.

This supplement of about 40,000 words—practically a small book—is a summary of the present science and art of geophysics, from which the non-technical man may gain a fair idea of what it is all about. There is a section on the history of geophysics as understood especially in relation to prospecting for petroleum; the origins of the three principal systems—electrical, gravimetric, and seismic—are traced. Another section describes the present positions of these methods as they are used in field surveying. The electrical exploration of drill-holes is then treated. After this general survey the actual technique employed in geophysical prospecting is extensively treated, the electrical and the seismic methods being given the greater prominence. The rest of the work is an exposition of world-wide geophysical operations and results, giving interesting particulars of the geophysical work that has been done and is still being carried on in practically all countries of the earth where men are hoping to find oil. A list is given of organizations (other than those in the service of particular oil companies) which execute geophysical surveys. The text is illustrated by a number of excellent photos and drawings. The mathematics employed seem to have been kept down to an irreducible minimum. The style is plain and the subject is presented so that the average man who is interested in oil prospecting, and especially one who wants to know the exact nature of the formations penetrated by an expensive hole in the ground, may understand what an expert has to say.

Concerning the future of geophysics the author points out that this is a young science which in solving old problems is continually disclosing the existence of others. As time brings improvements in existing practices and as new methods are introduced we shall eventually have information about the whole of the earth's crust to a depth of 20 miles, more or less. The contemporary importance of geophysical work is indicated by the fact that within the past 10 or 15 years no less than $130,000,000 has been spent on this form of industrial research, and on the whole this investment has made very handsome returns.

A PROPOSED PROGRAM OF GEOPHYSICAL EXPLORATION FOR NEBRASKA AND THE DAKOTAS.—John H. Wilson, in GEOPHYSICS, vol. 1 (1936), No. 2, pp. 189–195.

The area included in Nebraska and the Dakotas has not been held in high esteem by the oil industry because of (1) lack of production in the area, (2) lack of knowledge of stratigraphy and structure except on the margins of the basins, (3) because the few wells that have been drilled on supposedly good geological information have been dry, and (4) because of a belief that the sedimentary section is unfavorable for oil and gas. However, the author is willing to affirm that the Great Plains Basin is worthy of consideration and should be explored for oil and gas. In view of the vast size of the area he thinks that the best plan would be to first make a general reconnaissance survey by the seismic method, spacing the stations 10 miles apart. The object of this survey would be to determine the thickness of the sedimentary section at each location. Past experience has shown that this can be done with the requisite accuracy, although there may be local areas where the results would not be satisfactory. This procedure should locate the regional features, and where good reflections are obtained local detail work can be applied to attractive areas by the more intensive methods.

RADIO TRANSMISSION AND GEOLOGY.—Edmund M. Spieker, in BULL. AM. ASSOC. PETROLEUM GEOLOGISTS, vol. 20 (1936), No. 9, pp. 1123–1124.

Attention is called to a radio transmission map of Ohio which separates the state into four zones graded as to effectiveness of transmission, and is a generalized reflection of the lithologic map of the state. The best transmission is in the northwestern part of the state, the zone outlining roughly an area underlain dominantly by Ordovician, Silurian, and Devonian limestone. The next best zone follows a belt dominantly of shale, Devonian and Mississippian; the next, the Pennsylvanian-

Permian area of coal measures, highly varied in lithologic character and containing much sandstone. The poorest zone is an area near Cleveland which probably corresponds with a large channel or group of channels buried under Pleistocene materials. From these facts the generalization is obvious that radio transmission is affected by the texture of the rock immediately beneath the surface; tight, solid rock affords the best conditions and loose, open-textured materials the worst. This is supported by the fact that the values fall off notably as existing river channels are crossed, due perhaps, in part, to the topographic deflection, but probably also to the alluvium in the valleys.

Important applications of the principle in petroleum geology are not readily obvious, but they might appear in places where it is important to locate critical changes in bed rock near the surface and covered by alluvium.

Drilling

Protecting Oil Sands by Directional Drilling.—Alexander Anderson and T. K. Sawyer, in PETR. ENG., vol. 7 (1936), No. 12, pp. 36–37.

What is described as another type of problem to be solved by directional drilling is an unusual condition where two oil sands were exposed to high water pressure from an intermediate sand. Under ordinary circumstances new hole could be drilled and the section of sidetracked hole left undisturbed; but when such a section, plugged off at the top by cement, formed an unobstructed passageway for high pressure water to damage the productive sands, it was necessary to reenter the original hole so that the water sand could be cemented off.

Using a Lewis knuckle-joint as a deflecting tool, a side-track hole was run for a distance of some 250 ft. and a re-entry made into the original hole. This operation required some very careful manipulation.

Casing Line Data and Their Application.—Roy B. Southworth, in PETROLEUM WORLD (Calif.), vol. 33 (1936), No. 7, pp. 33–40.

In this paper it is noted that whereas all oil operators generally rack drill pipes, set mud pumps in the same manner and use the same types of rock bits, etc., nearly all have different methods of applying wire. This diversity of practice, which is noted not only in different oil fields but also even within a single organization, is perhaps due to the fact that a knowledge of the dynamics of wire ropes as used in oil well operations is not generally diffused. The author, who may be described as a wire rope engineer in the employ of a steel company, has conducted numerous cooperative experiments to determine what actually happens to wire lines in the drilling of an oil well. In these experiments hydraulic indicators were installed on both the fast- and the dead-lines with 8, 10 and 12 lines in the derrick; the data include total load, dead-line load coming out and going in, the same for live-line load, from which are calculated the theoretical load/line at different speeds and the efficiencies of blocks and line. The fact is disclosed that the load carried by the hook is not equally distributed between the 6, 8 or 10 lines up; that the fast-line carries the greater part of the load coming out and the dead-line the greater part of the load going in, from which some interesting conclusions are drawn. One is that it is highly advisable to use the larger sizes of rope wherever possible and particularly in the deeper wells; live-line loads should not be permitted to exceed one-fourth or one-fifth of the catalog breaking strength of the rope. Further, to increase rope life and safety of operation, ropes should be moved from the calf-wheel or standby draw-works to the draw-works drum more often than ever before. A sufficient movement should be made to prevent the point of tangency on the dead-line side from stopping at the point of tangency on the traveling block side of the dead sheave. Two operators are cited who move three ft. a day, one who moves four ft., and one who moves 15 ft. a week. When about 75 ft. has accumulated on the drum it is then cut off. In the short time this method has been in operation gratifying results have been obtained.

Natural Gas

Storage of Natural Gas in the Bow Island Field.—P. D. Mellon, in GAS AGE-RECORD, vol. 78 (1936), No. 4, pp. 97–99; 106.

The first major Canadian project of recharging a depleted natural gas field with gas from other fields is the refilling of the Bow Island structure located in Southern Alberta. The situation was as follows: the Bow Island field had become exhausted and offered an ideal receptive reservoir; the natural gasoline plants in the Turner Valley field, which were connected to the same transmission pipeline, were blowing into the atmosphere approximately 250,000,000 cubic ft. of gas a day.

A first experiment, in which 37,000 MCF of gas were transported under natural pressure from a nearby field and injected through eight wells into the Bow Island field, showed an increase of 30 lb. per sq. in. in the rock pressure. On the basis of this result arrangements were made to compress waste gas of the Turner Valley field, 150 miles away, and store it in the depleted Bow Island field. Of the 27 old wells in this field, 11 were selected for input wells, to which the charging gas is delivered under a pressure of 750 lbs. per sq. in. For this purpose there are employed three two-stage 200 h.p. direct-driven gas engine compressors having a combined capacity of 3,000,000 cu. ft. daily at 40 lbs. intake and 800 lbs. discharge pressure, equivalent to 5,000,000 cu. ft. at 400 lbs. discharge. The arrangement is such that the operation can be reversed and the gas sent out of the field either through the compressors or under natural pressure. To date nearly 8,000,000,000 cu. ft. have been stored, and the field is now under an equalized pressure of 502 lbs. The field is thus available for use during peak load demands or emergencies or as a reserve for future use.

Liquid Butane as Motor Fuel.—M. M. Holm, in IND. ENG. CHEM., analyt. ed., vol. 8 (1936), No. 8, pp. 299–300.

Use of liquid butane as motor fuel involves certain problems in refinement and handling not encountered with heavier fuels. Origin of the particular problems pertinent to this discussion centers in the specialized equipment required for proper vaporization and carburization of the liquefied gas. Conventional equipment for this service comprises a pressure-regulating valve, a heater, and a butane-metering valve. Presence of minute traces of contaminants in the fuel eventually results in improper functioning of this equipment. In many cases the concentration of interfering material may be so low as to defy detection by ordinary methods of analysis.

Contaminants may be grouped conveniently as insoluble scale and dirt; butane-soluble, noncorrosive, nonvolatile material; and material which is corrosive to metal equipment under service conditions. Insoluble scale and dirt present no great problem since they are normally removed by a metal screen placed in the liquid fuel line ahead of the pressure-regulating valve. On the other hand dissolved nonvolatile material, such as pipe-threading compounds and valve lubricants, even though not corrosive, has a tendency to collect at points of low gas velocity in the metering valve, eventually contributing to improper seating. Particularly objectionable is the corrosive type of contaminant, since it not only destroys the equipment but interferes with satisfactory operation before complete failure occurs.

Any test procedure for determining quality of a given fuel should be rapid and simple, and give results which can be interpreted in terms of actual service.

The author has devised such a test; it consists of an arrangement whereby the gasified butane is caused to stream over the face of thin copper or silver (or both) mirrors. After a few minutes a fuel may be rated as satisfactory or unsatisfactory on the basis of mere visual inspection of the mirrors. The nature of the contaminant may be ascertained by the application of microanalytical methods.

Pipelines

Cathodic Protection of Pipelines.—D. B. Good, in PETROL. ENG., vol. 7 (1936), No. 11, pp. 57–60.

The usual set-up for the cathodic protection of oil pipelines, gas lines, etc., consists of a source of D-C power, with the negative connection to the substructure that is being protected and the positive connection to a ground bed or anode from which the current is discharged, the return current being through the earth and the underground structure.

The quantity of current that passes through this circuit depends in the first place on the input of D-C electric power and on the resistance of the circuit, particularly the anode or ground-bed resistance, which varies in different parts of the country according to soils, general earth conditions and seasons. A prime factor is the water content (up to a certain point) of the soil in immediate contact with the anode; also, the contact resistance between anode and soil into which the drainage current is discharging is dependent to a certain degree on the chemical composition of the soil. However, other things being equal and constant, the constancy or variation in the total resistance of a protective circuit will depend on whether the soil is wet or dry.

Variation in the resistance of a ground bed

means that the amount and degree of protection afforded to a pipeline may or may not be adequate if dependence is placed on a constant voltage of the cathodic unit. The author cites instances and charts showing variations of circuit resistances in relation to meteorological conditions; there is a rise in times of drouth and a fall with the rains. It may be that a small drainage current in a dry season would be somewhat equivalent to a higher drainage current in wet seasons, but this would be true only if the soil were generally wet and corrosive in the pipe ditch while the ground bed is dry.

Avoidance of these variations of ground-bed resistance with the object of maintaining adequate protection at all times is a matter for consideration when the installation is being planned. If serious drying out of the ground bed is to be apprehended it may be advisable to arrange artificial measures for keeping the ground bed moist.

JUNK IRON AS A SOURCE OF CATHODIC PROTECTION TO UNDERGROUND METALLIC STRUCTURES.—S. U. McGary, in PETROL. ENG., vol. 7 (1936), No. 11, pp. 70–72.

The author describes a device for creating direct current for affording cathodic protection to a pipeline or other buried metallic structure. The device operates by corrosion of scrap iron to produce electricity. Into the bottom of a container of glass or wood is placed a copper plate which is covered with a concentrated solution of copper sulphate; above the copper sulphate solution is a one percent solution of calcium chloride to which ¼ percent of acetic acid has been added. Into the top solution is placed a piece of scrap iron which is to undergo corrosion and supply electricity. One terminal of such a battery is attached to the copper plate and the other to the iron plate. A layer of oil serves to exclude air.

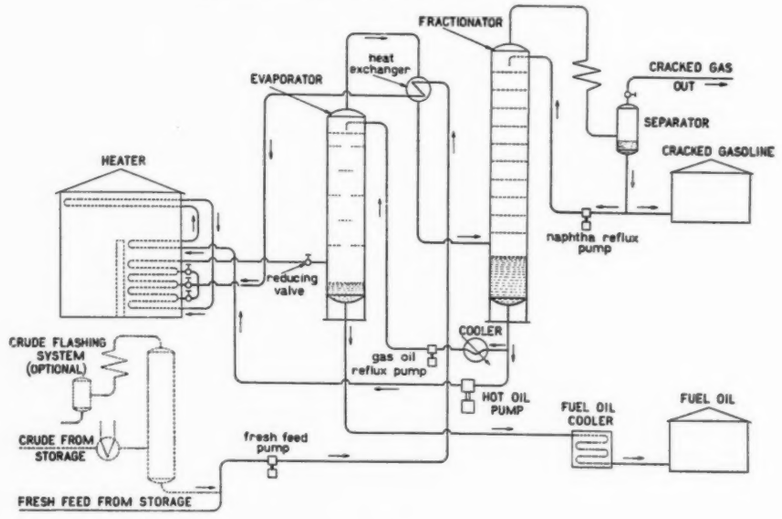
In practice an installation of this kind consists of several large casks (hogsheads); the plates in each end are about five ft. square. The casks hold enough chemicals for one year's continuous operation. Each cell is capable of delivering on short circuit 1.8 amps. with an open voltage of 0.7; under load at a particular location a cell delivered 0.9 amp. at 0.45 volt. The merits of the device are that it produces current economically, is applicable to any location, can be constructed in any size and involves no great cash outlay. Allowing for the salvage value of the copper the cost of producing one amp. for one year is $1.54. The disadvantage is that in order to produce a large amount of current it would necessitate a ground bed of very low resistance, which can be accomplished by using a large amount of scrap iron around which has been placed a large quantity of salt.

Petroleum Refining

THE "UNI-COIL" INJECTION PROCESS.—Communication of Petroleum Process Co. in PETROLEUM, vol. 32 (1936), No. 29, pp. 1–2.

The "uni-coil" process is especially adapted to the needs of small and medium sized refineries. From the accompanying flowsheet it will be seen that the process may be used either in a crude oil distillation plant or on raw material from some independent source.

Flowsheet—The "Uni-Coil" Injection Process



In any case the raw material is first pumped through a heat exchanger where it is raised to a temperature that is generally above 500 deg. F. It is then introduced into a stream of partly cracked gas oil of higher temperature which is circulating through the heat exchanger. The place where the injection of the raw material occurs depends on its character, on the degree of cracking to which the gas oil has been subjected up to the time of injection, and other factors. The mixture of original oil and partly cracked gas oil now passes into a "soaking zone" in which the viscosity of the heavier fractions is broken and the cracking of both components of the mixture is substantially completed. The temperature of this soaking zone generally lies between 850 and 900 deg. After leaving the coils the product passes to the evaporator for removal of volatile constituents. Since there is no "quenching" by mixing with colder oil it is possible to keep the evaporator at a temperature that will assure complete separation of the cracked residue. The rest of the process is self-evident.

The chief advantage of the "Uni-coil" injection process lies mainly in its heat economy. This arises from the fact that the temperature of the starting material is quickly raised to 500 deg., the additional heat required for breaking the viscosity being supplied by the stream of cracked oil. The heating surface is therefore considerably reduced. Hence the small refinery need use only one heating coil, which makes it easier to regulate the temperature. At the same time the process has a wide range of adaptability.

DESIGN OF SOLVENT EXTRACTION PLANTS FOR MANUFACTURE OF LUBRICATING OILS.—I. G. Hunter and A. W. Nash, before 3rd World Energy Conference, London, 1936. Paper No. C–18. 26 pp.

The object of solvent refining is to produce lubricating oils of the Pennsylvania type from any crude oil that may contain suitable hydrocarbons. In designing a plant for this purpose it is necessary to make some preliminary experiments that will show (1) the quantities of both liquid phases in equilibrium, (2) the quantity of solvent in each phase, and (3) some physical property of the oil that is constant in each phase in equilibrium; a suitable constant in this sense is the viscosity-gravity index. These data are used as the bases of triangular coordinates, one of which shows the v.-g. index; the opposite leg of the triangle shows percent of oil and the third leg percent of solvent. On this diagram are graphed the experimental results obtained by extracting the oil with different volumes of the solvent. From such data it will be possible to calculate the yield of refined oil, the quantity of solvent carrying the refined oil, quantity of extract, solvent carrying extract, the optimum number of steps in the extraction process, etc. These results are then used in dimensioning the plant. The authors give the accompanying data relating to the solvents now mostly used.

Data Relating to Solvents Now Commonly Used

Solvent	Bbl. oil per day	Cost per bbl. of oil treated, cents	Solvent loss %
SO_2	–	8–10[1]	–
SO_2—benzol	2,000	17	–
SO_2—benzol	1,500	21–22	–
Phenol	1,200	14–5[2]	0.15–0.10
Chlorex	1,000	17–20	0.04
Furfurol	–	17–18	0.025
Nitrobenzene	1,000	27–34	0.1
Nitrobenzene	1,000	30–42	0.2

[1] Treating kerosene and light oils.
[2] Labor and overhead not considered.

In solvent extraction it is most important to secure intimate mixture of the oil and solvent. The oldest and best known mixing device is the paddle agitator; use is also made of screw propellers and centrifugal pumps in the feed lines. Mixing may also be accomplished by injecting the solvent into the pipe carrying the crude oil. Still another way is to employ a contacting column with large surface, through which solvent and oil may flow countercurrently.

To date no thorough studies have been made

to compare the efficiencies of different types of equipment for solvent extraction. Such information as is at hand indicates that the most appropriate is the type of extractor with mechanical agitation where the two liquids are flowing in counter current.

Influence of Peroxides on Gum Formation in Cracked Gasoline.—O. Pipik and E. Mezhebovskaya, in OIL & GAS JOUR., vol. 35 (1936), No. 9, pp. 50–57.

This is a Russian research, translated under auspices of the petroleum division of the American Chemical Society as a matter of general interest. The problem of refining cracked gasoline and preventing gum formation requires that the oxidation of gasoline be studied in all its stages. In their study of the connection between the presence of peroxides in gasolines and the formation of gums, the authors used two methods of approach: (1) removal of peroxides already present in gasoline and comparison of the velocity of autooxidation of the purified gasoline with that of the original sample, and (2) study of the development of peroxides and gums in untreated and refined gasolines. Their conclusions and recommendations are stated as follows:

1. In certain cases the curve of gum content as a function of time is similar to the curve of the formation of peroxides; it may be assumed that the formation of gums is closely connected with the concentration of peroxides.

2. In some untreated gasolines after prolonged storage a decrease in peroxides and an increase in gums is observed. This we do not consider to be contrary to the correlation between the presence of peroxides and the tendency to gum formation, but assume that peroxides are converted to gums.

3. In a number of cases the amount of peroxides in refined samples is greater than in untreated ones; since the formation of gums in refined samples takes place at a slower rate, it is easier to observe the intermediate stage of oxidation which is the formation of peroxides, while in untreated samples the peroxides are quickly transformed into gums and therefore may not always be found.

4. As the peroxides represent one of the stages of the auto-oxidation of gasoline it is necessary to have them removed and prevent their reappearance.

5. Of the various methods of removing peroxides investigated by us the most effective appears to be the passing of gasoline in vapor phase through Florida earth. However, after a certain period of time peroxides begin to reappear in gasoline refined with Florida earth.

6. Inhibitors retard the formation of peroxides in gasoline. In order to obtain the highest inhibiting effect the inhibitor should be added immediately after the refining, while the gasoline is still free of peroxides.

Conversion of Petroleum Gases into Useful Hydrocarbon Products.—A. E. Dunstan and D. A. Howes, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 152, pp. 347–413.

The profitable utilization of petroleum gases has received much attention during the past 20 years. At the outset the object was almost entirely one of conservation. The gases available were waste products and it was desired to convert these into marketable material, attention being concentrated on the production of synthetic hydrocarbon spirits. Then an urgent demand arose for the highest quality motor fuel, and research has eventually shown that the two requirements of conservation and super-quality products could be met simultaneously.

This extensive article is a review of this research. The methods that have been made available for the production of higher molecular weight hydrocarbons (e.g. gasoline) from petroleum gases are described and discussed in much detail. These methods are classified as follows:

A. *Applicable to both Saturated and Unsaturated Gases.*

1. High-temperature, low-pressure pyrolysis primarily to produce aromatic hydrocarbons—the so-called Benzole Pyrolysis. 2. Low-temperature, high-pressure treatment involving pyrolysis and subsequent polymerization in the case of saturated gases and only polymerization and condensation in the case of unsaturated gases.

B. *Applicable to Saturated Gases.*

1. Pyrolysis to unsaturated hydrocarbons followed by polymerization processes. 2. Dehydrogenation to unsaturated hydrocarbons followed by polymerization processes.

C. *Applicable to Unsaturated Gases.*

1. Catalytic Polymerization. 2. Sulphuric Acid Polymerization.

In addition, there are various processes by which saturated and unsaturated hydrocarbons may be condensed—so-called Alkylation Processes.

The gasolines produced by some of the above processes may be improved by non-destructive hydrogenation—*i.e.*, reduction of olefinic products to the corresponding saturated hydrocarbons. In this classification the term high-pressure is applied to pressures above 300 lb. gauge and the term high-temperature to temperatures above 600 deg. C.

The discussion of phosphate catalyzers used in petroleum polymerizations is especially full.

Ketone-Benzol Dewaxing Process.—George Weber, in OIL AND GAS JOUR., vol. 35 (1936), No. 9, pp. 46–48.

A description and flow-sheet are given of a new solvent dewaxing plant operated by the Gulf Oil Corp. at Port Arthur, Texas. The unit, which is the first of its kind, operates on a blend of 100 percent Pennsylvania grade stocks prior to their treatment by the Alchlor process in manufacture of lubricating oils. The solvent employed is a mixture of methylethyl ketone and benzol, and to some extent is similar to the acetone-benzol process. As in this latter process, a large fraction of the solvent mixture consists of benzol, which acts as a solvent for the oil. The function of the ketone is to act as anti-solvent or precipitant for the wax fraction of the oil; the two constituents are used in the ratio of 3 parts benzol (90 percent grade) to 2 parts methyl-ethyl ketone. Charging ratios vary from 3.5 to 4 parts solvent mixture to 1 part of oil by volume.

In operation, the oil and the solvent mixture are mixed together in charging heads, precooled by heat exchange with the dewaxed mixture from the filter presses and then lowered to the proper temperature in direct expansion ammonia chillers where operating temperatures of 4° deg. are easily attained. In obtaining a high yield of low pour-point oil, a spread of only 15 to 20 degrees is required between the actual chilling temperature and the pour-point of the product.

From the chillers the mixture is passed to Vallez filters where the wax is removed and washed; the wax-free filtrate is then passed to the solvent recovery apparatus. All operations except the filtering are automatically controlled. Steam only is used for heating to reduce fire hazard. Solvent losses are low, as the system is gas tight.

Petroleum Chemistry

The Smoke Tendency of Refined Kerosene.—John B. Terry and Edward Field, in IND. ENG. CHEM., analyt. ed., vol. 8 (1936), No. 8, pp. 293–297.

In recent years investigations of the chemical constitution of kerosenes of different degrees of refinement have shown that the constitution of any kerosene is closely related to its tendency to smoke in a given lamp. The tendency to smoke is directly proportional to the aromatic or napthene content. In the homologous series of the aromatics the tendency to smoke decreases as the number of atoms or boiling point increase, the reverse being true of the paraffin series.

The smoking quality is measured by burning the kerosene in a special lamp and noting how high the flame may be raised without smoke. The difficulty with this test is the construction of a suitable lamp. This difficulty has been satisfactorily removed by the improved factor lamp described and illustrated by the authors. In this lamp a very highly refined kerosene will give a smoke-free flame three inches or more high, a well refined stock about two inches, and an inferior grade less than one inch.

With care and proper attention to details, results on duplicate samples of inferior and well refined kerosenes should agree within 0.05 inch in height; with very highly refined kerosenes within 0.10 inch.

Products of Vapor-Phase Oxidation of Hydrocarbons.—W. De Piotrowski and J. Winkler, in OIL AND GAS JOUR., vol. 35 (1936), No. 9, pp. 58–59.

This is a Polish contribution to the rather scarce literature of the oxidation of hydrocarbons in vapor phase. A process worked out by the authors is briefly described as follows:

As starting material, a mixture of hydrocarbons having the specific gravity 0.770–0.850 at 15 deg. C. and boiling between 170-250 deg. C. is used. It is pre-heated in heat exchangers to the temperature of about 150 deg. C. and then mixed with the measured quantity of air heated to 300 deg. C. The hot mixture of hydrocarbon vapors and air enters in the reaction chamber containing the contact mass. There the reaction between air-oxygen and the vapors of hydrocarbons takes place. The reaction is exothermic, although a very small amount of CO and CO_2 is formed by complete combustion. The quantity of CO and CO_2 in the combustion gases amounts to 1–1.5 percent by volume.

The highest yields of products are obtained by keeping the temperature of the reaction accurate; therefore, it is necessary to lead away the excess heat formed by the catalytic reaction.

The gases leaving the reaction chamber

separate some heavy resinous compounds and, later in a rectification column, the parts boiling above the determined temperature. From the column the vapors pass through two coolers and an absorption tower where they leave all condensible fractions. The noncondensed gas is used partially as fuel for the installation and the rest is conducted to the supply system of the factory. The liquid and solid products obtained from the reaction are redistilled and fractionated.

Detailed investigations have led to the conclusion that the process of catalytic oxidation in the vapor phase follows at least six simultaneous reactions. Two of them are conserving, two decomposing and two polymerizing, namely:

1. The conserving-dehydrogenating reaction:
   $C_nH_m+aO_2\rightarrow C_nH_{m-4a}+2aH_2O$
2. The conserving-oxidizing reaction:
   $C_nH_m+O_2\rightarrow C_nH_{m-2}O+H_2O$
3. The destructive-dehydrogenating reaction:
   $C_nH_m+aO_2\rightarrow C_pH_q+C_xH_y+2aH_2O$
   whereby: $p+x=n$, $q+y+4a=m$
4. The destructive-oxidizing reaction:
   $C_nH_m+2O_2\rightarrow C_pH_qO+C_xH_yO+H_2O$
   whereby: $p+x=n$, $q+y+2=m$
5. The polymerizing-dehydrogenating reaction:
   $2C_nH_m+aO_2\rightarrow C_{2n}H_{2m-4a}+2aH_2O$
6. The polymerizing-oxidizing reaction:
   $2C_nH_m+O_2\rightarrow C_{2n}H_{2m}O+H_2O$

From the above mentioned reactions it may be seen that during the process of catalytic oxidation of hydrocarbons in the vapor phase a whole series of complicated reactions take place. The products obtained are partly heavier and partly lighter than the starting product. Both contain oxygen compounds and hydrocarbons having a lower hydrogen-carbon ratio than the starting material.

In spite of numerous attempts no catalyst could be found which would influence the reaction in the direction to form only one definite type of product. Therefore it proved necessary to be satisfied with a catalizer allowing the lowest temperature of oxidation, 260–300 deg. C., and simultaneously to get the highest yield of oxidized and dehydrogenated hydrocarbons, avoiding thereby the formation of worthless CO and CO_2. Varying the composition of the starting material, the rate of flow and the reaction temperature, either the oxidation or the dehydrogenation may be made predominant.

The products have found use as bad smelling substances for denaturing alcohol and odorizing city gas, as inhibitors of precipitation in city gas and in cracked gasolines.

Reactions of Olefins in the Presence of Metals.—Gustav Egloff and C. I. Parrish, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

Olefins undergo the three type reactions of polymerization, isomerization, and decomposition. The degree to which an olefin reacts in the presence of metals depends upon the condition of the metal and the contact time. Decomposition to carbon and hydrogen is the most predominant in all cases at the longer times. The metals favoring the formation of higher hydrocarbons at temperatures below 200 deg. C. are copper, cobalt, iron, nickel, platinum, silicon, and sodium. Those which have caused isomerization are platinum and sodium. All the metals studied promote the decomposition of olefins if the contact time is long enough. With reference to the periodic chart, representatives from groups I, IV, and VIII were used for polymerization; I and VIII for isomerization; and I, II, III, and VIII for decomposition.

The treatment of olefins with metals produces gases, liquids, and solids dependent upon conditions of time, temperature, and pressure.

A complete bibliography will be included together with details of the experiments in the final paper.

Thermal Reactions of Ethylene.—Robert E. Burk, Bruce G. Baldwin, and C. H. Whitacre, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

The thermal reactions of ethylene at 625 deg. C., one atmosphere, 12 seconds reaction time, have been investigated. Oxygen was removed. Acetylene, butylene, and butadiene were added to the ethylene in separate experiments. The reaction order was determined and found to be between the first and second.

The main products are butylene, propylene, butadiene, and volatile liquids. All of the results can be interpreted on the basis of the occurrence of two primary reactions: (1) direct polymerization to butylene, (2) dehydrogenation to acetylene. The other products are thought to be secondary.

Analysis of Light Petroleum Fractions.—S. S. Kurtz, Jr., and C. E. Headington, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

This paper describes a method for the semi-quantitative determination of (1) conjugated diolefins, (2) cyclic mono-olefins, (3) non-cyclic mono-olefins, (4) paraffins, (5) naphthenes, or saturated cyclic compounds, and (6) aromatics, in light petroleum fractions boiling from 40 to 200 deg. C.

The method involves chemical treatment of the material with maleic anhydride and sulfuric acid, fractionation into 30 deg. C. cuts, and measurement of density and refractive index of the cuts. Calculation of results depends on graphical methods and is bettered by use of a new constant—the refractivity intercept.

Petroleum Physics

A Method of Separating Butenes From Butanes: Distillation of Azeotropic Mixtures with Sulfur Dioxide.—M. P. Matuszak and F. E. Frey, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

It has been found that four-carbon hydrocarbons form minimum-boiling azeotropic mixtures with sulfur dioxide. The order of the boiling points is different from that of the boiling points of the hydrocarbons themselves. This permits practical separation into a butene fraction and a butane fraction. Equilibrium compositions of both liquid and vapor phases at various temperatures have been accurately determined for various mixtures of sulfur dioxide and four-carbon refinery fractions. Vapor pressures have also been determined at various temperatures. The data are of considerable theoretical interest because of the light they throw upon the existence of azeotropic mixtures.

Apparatus for the Fractional Distillation of Liquefied Gases.—Arthur Rose, before Am. Chem. Soc., Gas & Fuel Div., Pittsburgh, 1936.

The apparatus described is such that its operation can be easily mastered and it gives a boiling point curve that is smooth and independent of all reasonable variations in condenser temperature and heat input to the still. At the same time the apparatus is relatively inexpensive and simply constructed.

Use of Acetic Acid for Separating, by Distillation, the Two Classes of Hydrocarbons, Naphthenes and Paraffins, Found in Constant Boiling Fractions of Gasoline.—S. T. Schicktanz, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

Constant boiling fractions of gasoline boiling in the temperature range 130–174 deg. C., and consisting of naphthene and paraffin hydrocarbons, can be successfully separated by distilling with acetic acid. The azeotropic mixtures formed by the hydrocarbons and the acid aid in concentrating the paraffin and naphthene groups, which, although never absolutely pure, can be separated further by other physical methods. This includes the interlocking of acid distillation with straight oil distillation and subsequent crystallization.

Viscosity of Liquid Ethane, Propane, and Butane.—Ogden FitzSimons, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

A new viscometer suitable for the determination of the viscosity of liquids at temperatures above their normal boiling points is described. Data are presented on the use of this instrument for the determination of the viscosities of liquid ethane, propane, and normal butane over the temperature range from −40 deg. C. to +40 deg. C.

Relationships Between Physical Properties and Chemical Constitution of Lubricating Oil Fractions.—Beveridge J. Mair and Charles B. Willingham, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

A correlation of the physical properties of a series of petroleum fractions in the lubricating oil region with each other and with the physical properties of synthetic high molecular weight hydrocarbons has been made. The petroleum fractions had been extensively separated by distillation and extraction and their empirical formulas determined. The following properties were compared: densities, specific refractions, optical activities, specific dispersions, viscosities, viscosity indices, aniline points, and boiling points.

It appears that the least soluble portion of the oil—that is, the material presumably corresponding to the very best product of any good solvent extraction process, consists substantially of naphthenes (cycloparaffins) containing from one to about two or three rings per molecule together with the necessary alkyl radicals. The somewhat more soluble portion consists of naphthenes with more rings, to-

gether with some unsaturated hydrocarbons and possibly some aromatic hydrocarbons. There is no evidence whatever for the existence of iso or branch chained paraffins.

Because of the similar solubility relations, it is possible that, in the extraction processes as used at the present time, one-ring aromatic hydrocarbons are being discarded to waste along with the undesirable naphthenes of five or six rings per molecule. This is a point well worth investigating, since these one-ring aromatic hydrocarbons may be a valuable constituent for good lubricating oil.

Molecular Weights of Viscous Petroleum Fractions.—J. R. Keith and L. C. Roess, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

Cryoscopic molecular weights have been determined on Mid-Continent and Texas Coastal crude distillates having viscosities between 36 and 150 Saybolt Universal seconds at 210 deg. F. A characteristic curve was obtained for each crude by plotting molecular weight against viscosity at 100 deg. F., and the difference between the molecular weight-viscosity relations of samples from these two sources was used as the basis for establishing the effect of the slope of the viscosity-temperature curve on molecular weight and subsequently formulating a general correlation of molecular weights with viscosities at 100 and 210 deg. F. This correlation is thought to be superior in scope and accuracy to the one developed by Fenske, McCluer, and Cannon, and agrees very satisfactorily with published data.

Separation of an Isononane from Petroleum; Its Fractionation from Naphthenes by Distillation with Acetic Acid.—Joseph D. White and Frank W. Rose, Jr., before Petrol Div., Am. Chem. Soc., Pittsburgh, 1936.

A nonane boiling at 135.2 deg. C., possibly a dimethylheptane, has been isolated from Oklahoma petroleum. It was found closely associated with naphthenic hydrocarbons in a distillation fraction boiling normally between 135 and 136 deg. C. from which aromatic hydrocarbons had already been removed. Separation of the mixture by distillation with glacial acetic acid yielded a fraction highly concentrated in the nonane, from which the compound was finally isolated by crystallization from solution in liquid dichlorodifluoromethane.

The physical constants of the nonane have been determined and compared with those of nonanes known to boil near 135 deg. C. It has properties similar to those of 2, 6-dimethylheptane, but the agreement is not sufficient to identify the compound completely. It constitutes about 0.1 percent of the crude petroleum.

Use of Petroleum

Amorphous Paraffin Wax as a Protective Coating and Dustproofing Agent for Solid Fuels.—H. R. Fife and P. W. Edeburn, before Am. Chem. Soc., Gas & Fuel Div., Pittsburgh, 1936.

A study of dust-laying practices on soft coals emphasized the need of a more permanent treatment than is commonly used. A soft amorphous paraffin wax was found to possess a high degree of dust-laying and retention properties and to be capable of preventing the formation of further quantities of fly dust during handling after storage. Three methods of applying petrolatum (mixture of oil and amorphous wax) were investigated. These include pressure spray, steam spraying, and dipping into a hot water suspension of wax. The first two methods were found applicable to all types of solid fuels, while the third was found satisfactory for clean lump coals only. The petrolatum film on the Freeport coal decreased oxygen absorption by virtue of sealing the surface and preventing the exposure of a larger surface.

Asphalt and Tar

Tar as a Fuel.—J. G. King and C. M. Cawley, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 154, pp. 595–601.

Tars and tar distillates require very little treatment to render them suitable for external combustion. After a normal refining treatment gas spirits and low-boiling tar oils make excellent motor spirits, of high octane number, either for direct use or for blending purposes. The burning of light creosote oil in spark-ignition internal-combustion engines, after giving some promising results, has proved on the whole to be a failure.

The slow-speed Diesel engine requires very little adaptation to make it suitable for the combustion of heavy tar oils, but these cannot be used in the high-speed Diesel engine, owing to the difficulty of obtaining rapid ignition. Suitable means have been found for the reduction of the ignition temperature and the ignition delay of tar oils, but none of these has yet proved a commercial proposition.

The present tendency is to regard tar less as a fuel and more as a raw material for the production of fuels by processes such as cracking and hydrogenation. The cracking process has a possible application to low-temperature tar or its distillates, but not to high-temperature tar or its distillates. The hydrogenation process gives large yields of motor spirit from all tars, but has not yet been successful in producing oil suitable for the high-speed Diesel engine.

Rheological Properties of Asphaltic Bitumens.—J. Ph. Pfeiffer and P. M. Van Doormaal, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 22 (1936), No. 152, pp. 414–440.

Asphaltic bitumens are employed in an almost unlimited number of technical applications. Besides road-making, there are numerous industrial applications, examples of which are: the roofing felt industry, the paper and textile industries, the cable industry, the manufacture of briquettes and of bitumen compositions for the protection of pipelines or for the production of bituminous paints, etc.; further, of late years they have come to be used for various hydraulic purposes as well. For this reason it has become necessary to acquire a thorough knowledge of the physical and chemical properties of these materials.

Among the properties of bitumens and asphalts that come prominently into consideration is their rheology, a word which in general denotes resistance as manifested in viscosity, hardness, plasticity, shearing, etc. It is a complicated subject for which it is desirable and important to find a simplified expression. A useful index is the angle of incline of the penetration-temperature curve, or the "susceptibility to temperature change". With the aid of an index nomogram given in the paper, this "temperature susceptibility" of a bitumen can be expressed by a figure when the penetration at 25 deg. C. and the Ring and Ball melting point, or the penetration at any two different temperatures are known. The authors give a working hypothesis of the constitution of asphaltic bitumens which asphalt technologists may find useful.

Petroleum Substitutes

Motor Fuel from the Cracking of Oils Produced by the Catalytic Water Gas Reaction.—Gustav Egloff, Edwin F. Nelson, and J. C. Morrell, before Petrol. Div., Am. Chem. Soc., Pittsburgh, 1936.

The process of producing hydrocarbon oils from coal is in commercial use, via carbonization at low and high temperatures, hydrogenation, and the water gas reaction.

The catalytic conversion of hydrogen and carbon monoxide or water gas into liquid hydrocarbons predominantly paraffins and olefins was discovered by Fischer and Tropsch. It is reported that four commercial plants are building or under construction in Germany to produce hydrocarbon oils. The product is referred to as Kogasin.

The gasoline derivable from the hydrocarbon oil produced by the catalytic treatment of water gas has a low octane number of 40 and therefore requires reforming to produce a product suitable for modern motors. By fractionating a very light gasoline out of the oil, subjecting the naphtha and bottoms to selective cracking conditions, and polymerizing the olefins present in the gas, a yield of over 84 percent of 66 octane number gasoline is obtainable.

Motor-Alcohol in Italy.—G. Reinboth, in ZUCKERRUEBENBAU, vol. 18 (1936), No. 7, pp. 114–116.

It is said that two Italian engineers, Marchetti and Parcopasso, have invented a carburetor that will burn alcohol with as much as 20 percent of water and give good results in an automotive engine. The new invention has been tested and approved by the Royal Italian Academy, and has been installed in the automobiles used personally by Mussolini, the Fascist chief.

One result of the invention and approval of this new carburetor has been an expansion of the program to make Italy independent of foreign sources of automotive fuels. The original plan called for an increase of sugar beet culture sufficient to provide enough alcohol for a 20 percent mixture with all gasoline consumed in the country. It has now been decided to produce enough alcohol to run all trucks and other

heavy vehicles on straight alcohol fuel, while still maintaining the 20 percent mixture for ordinary automobiles. With this objective in view, an intensive official propaganda campaign has been started to expand the area planted in beets, and the culture of this crop will eventually be extended into many regions where the beet has not heretofore been grown. A price of 215 Lire per hectoliter has been guaranteed to all distilleries working on agricultural products. As a result of this action, additional distilling capacity has been created to furnish 500,000 hectoliters of alcohol a year and this is to be more than doubled as soon as possible. To use the new fuel it will be necessary to change the carburetors on existing automotive vehicles, but this change will not be expensive.

Petroleum Economics

THE FRENCH OIL TRADE UNDER THE NEW REGIME.—Oskar Tokayer, in PETROLEUM PRESS SERVICE, vol. 3 (1936), No. 28, pp. 219–220.

After a bitter price-war in the French gasoline trade, which lasted for nearly two years and involved all concerned in heavy and continuous losses, negotiations for an agreement had, just before the outbreak of the recent strike movement, progressed to a stage where a better future appeared in prospect for the French oil industry. These negotiations aimed at the setting up of a cartel comprising nine-tenths of all French importers and distributors, and gave promise of the establishment of prices on a more economic basis. The selling price for one hectolitre of gasoline had actually just been increased from its lowest level of 188 fcs. to 210 fcs. when the increases in wages and the new social laws came to upset hopes of re-establishing a balance between costs and prices, for which the negotiators had worked so hard.

The new social measures, including, as they do, wage increases, paid holidays and the probable introduction in the near future of the 40-hour week, will raise the wages costs of the French petroleum industry by some 30 percent. Although the oil industry, one of the most modern industries in France, will be less seriously affected by the new measures than many other branches of industry, as the share of labor costs in the selling prices of oil products is relatively small, the new charges will, on the other hand, have to be borne by an industry which has been working at a loss for a number of years.

The main burden of the increased costs will have to be borne, for the time being, by the French oil refiners, as they cannot raise prices if the importers of finished products do not do the same.

EUROPE'S HUGE BILL FOR ALCOHOL FUEL.—Oskar Tokayer, in WORLD PETROLEUM, vol. 7 (1936), No. 6, pp. 309–318.

Compulsory sale of alcohol as a motor fuel has been adopted in a dozen European countries (and others. Ed.). There are two assignable reasons for this trend: the great depression, which seriously impaired the economic position of the agricultural industries to which the manufacture of alcohol afforded a wider outlet for farm products, and the desire of many countries with scanty petroleum resources to increase their indigenous supply of automotive fuel as a measure of national defense and to economize on their supply of foreign exchange. However, these benefits resulting from the policy of enforced use of alcohol are obtained by heavy expense and sacrifices in other directions. In the first place, alcohol as a motor fuel is inferior to gasoline; in the second place, the cost of production of alcohol greatly exceeds the cost of production of gasoline. Not only does the automobile owner have to pay more for his fuel, but the national treasuries of the nations which put this burden upon him are deprived of the revenue that would be collected on the gasoline that is displaced by alcohol (which is taxed very lightly or not at all); this yearly loss of taxes is estimated at an average of $36 per car. The regulations and pertinent statistics of alcohol production and use are extensively discussed in the article.

Note: As the author observes, logical objections to the gross discrepancy between expenditure and benefits which is inherent in the policy of alcohol mixtures have been unavailing to check the spread of this policy, and there is small hope that it will be abandoned or even curtailed. It seems to be a fact that in the new concepts of social-economics, price is being demoted from its former place as a measure of relative values in national housekeeping. Recent events in the United States give strong indications that the American petroleum industry will hardly escape this movement. Ed.

CONTROL OF THE POLISH OIL INDUSTRY.—Oskar Tokayer, in PETROLEUM PRESS SERVICE, vol. 3 (1936), No. 29, p. 227.

The arrangements made between refiners for the restriction of Polish lubricating oil production have now been in force for some months. These arrangements were rendered necessary by over-production and over-stocking, which threatened to accentuate the losses already being incurred by the Polish oil industry in other directions.

The agreement concluded provides for the restriction of lubricating oil output to a quota based on a uniform percentage of production for all classes of refiners, this quota being subject to alteration in accordance with market requirements. Any lubricants produced in excess of the quota must be exported. Owing, however, to restricted manufacture of refined lubricants there has been a large increase in the production of unrefined distillates, so that, unless new foreign markets can be found for Polish lubricants, exports will in practice consist mainly of distillate fuels.

The fixing of quotas for lubricating oil has necessitated the control also of gas and fuel oil production for the home market and these products have therefore also been brought into the agreement.

It is still too early to estimate the full effects of these restrictions. It is enough to remark that, with the arrangements for regulating lubricating oil and gas and fuel oil output, nearly all branches of the Polish petroleum industry are now subject to stringent and uniform control. Yet it is certain that no amount of organization of this sort will bring about a lasting recovery so long as the Polish government does nothing to stimulate domestic consumption of oil products. In the years 1931–35 the domestic consumption of gasoline decreased by 32 percent and the total consumption of petroleum products by 7 percent. Even Diesel oil sales, which in many European countries have shown a remarkable rise in recent years, have fallen in Poland during the same period by 6 percent. This is undoubtedly due to the lack of development of the Diesel motor and the suspension of plans for the use of Diesel traction on the railways. In spite of oft repeated official statements that Diesel engines would shortly be introduced on all the principal lines, they are actually being employed only on the Warsaw-Lodz and Krakow-Zakopane sections.

General

CRACKING OIL UNDERGROUND.—Anon., in OIL NEWS, vol. 40 (1936), No. 1235, p. 72.

This article contains an excerpt from a statement by Alexander Sheinman, inventor of a process for cracking oil underground by which it is expected to revive production in certain nearly exhausted fields of the Staro-Grosny district. As outlined, the method is as follows:

Gas, heated to a temperature ranging from 600 deg. to 650 deg. C., is forced into the well at a pressure of 18 atmospheres. Thereby the oil is ignited in the strata and combustion is maintained by constantly pumping in air. With a temperature of 1,400 deg. to 1,500 deg. C. thus created, the oil is separated from the sand and pushes through to the wells. There the oil accumulates and is pumped out in a liquid state, or comes out of itself as a gas, which is then reworked into oil products.

"It is interesting to note that oil obtained by thermic methods is cracked underground. In our experiments we have received from the wells gasoline of a very high calorific value.

"The advantage of the thermic method and underground gasification lies in the fact that they do not require a great deal of capital expenditure. The old wells, through which the oil was previously pumped out, and compressors, which are to be found in all oil fields, are quite suitable for the new method of obtaining oil and gas. The Central Oil Administration of the U.S.S.R. is doing much work to introduce the thermic method of obtaining oil and for underground gasification. In addition to the Grosny, Maikop and Chusovsk oil fields, this work will also be carried out in the Stalin and Lenin oil fields at Baku."

CHEMICAL TRENDS IN THE PETROLEUM INDUSTRY.—M. B. Hopkins, in WORLD PETROLEUM, vol. 7 (1936), No. 7, pp. 356–359.

Not so long ago the refining of petroleum was mainly a physical process based largely on distillation. These physical processes are still employed, but are being supplemented, and in many cases overshadowed, by chemical processes in which elements existing in the raw material are taken apart and put together again in more desirable forms. It is safe to say that perhaps half the petroleum products now on the market never existed as such in the crude oil.

Among synthetic petroleum products now occupying the center of interest are new high-octane fuels for aviation purposes. The first of these materials was iso-octane, produced by polymerizing and hydrogenizing iso-butylene (itself produced by cracking petroleum). This

has now been followed by a still better product, isopropyl ether, which is made from isopropylene, another cracked product. Ultimately, these superior fuels will, without doubt, become generally available to the automotive industry.

Although the main business of the petroleum industry is to supply liquid fuels and lubricants, the synthesis of a wide range of products for various uses has assumed a considerable place in the industry's program. Paraffin hydrocarbons are now being converted into alcohols, glycols and solvents for many of the purposes of industrial organic chemistry; other petroleum products include resins, fungicides, detergents, chemical intermediates, drugs, rubber and a long line of new and old products, the mere listing of which would require much space. Besides producing chemicals for other industries to use, the petroleum industry is now making large use of chemicals originating in other industries, as, for instance, the new solvents that are being used for refining lubricating oils. The preparation of lubricating oils has of late become a chemical science in itself. New substances have been discovered or invented whereby these oils can be given properties that render them superior to those refined from Pennsylvania crude, which have heretofore been considered as the standard of quality. In the United States, chemical research in petroleum and related fields probably equals in quality, as well as in volume, the chemical research in all other branches of industry combined.

Oil Pollution of the High Seas.—Anon., in PETROLEUM, vol. 32 (1936), No. 26, p. 7.

The committee of experts appointed by the League of Nations to study the question of pollution of the high seas by tank steamers and motor ships is preparing a report containing the following provisions: The subscribing nations agree to prohibit vessels under their flags from emptying oil or oily mixtures in certain zones. These zones will be defined by each nation concerned, but normally will not extend beyond 50 nautical miles from the coast, except where special configurations of the coast line make it necessary to extend the prohibited zone out to a distance of 150 sea miles along the normal navigation route. In any case, oil is not to be thrown out in a manner such as will leave on the water an oil film visible to the eye in full daylight. Each ejection of oil must be noted in the ship's log with exact indication of the ship's position. Violations of these rules are punishable by the nation whose flag the ship is flying. Provision is made for international arbitration of disputed cases.

Reviving Production in Exhausted German Oil Fields.—Walter Sack, in OIL WEEKLY, vol. 82 (1936), No. 4, pp. 19–21.

Probably the greatest feat of the German petroleum industry was the revival of the nearly exhausted sands of the Wietze-Steinfoerde oil field in Hannover province.

In this field the productive sands average 60 ft. thick and 500 to 1,000 ft. wide; at the shallowest place they are 122 ft. below the surface, this depth being increased by the dip to 600 ft.; the productive area lies within 4,000 and 5,000 acres. The structure is a monocline pushed up by a salt dome in the form of a wide dyke. After the war the production of the field dwindled to practically nothing while three-fifths of the original oil remained in the sands, unrecoverable by any of the usual devices. In view of the meagre supply of German petroleum and the scarcity of foreign exchange, it was decided to make a new attack on this old field by sinking a shaft below the oil sands, and draining the residual oil by gravity.

With this idea in view a shaft 700 ft. deep was sunk. Lateral tunnels were run under the sands from the 350 ft. level and from the bottom of the shaft parallel to the length of the field; from these tunnels crosscuts were driven so as to divide the whole structure into blocks 600 ft. wide, and from the roofs of these tunnels holes were driven upward into the oil sands. The oil draining from these holes was run into sumps and lifted to the surface by ordinary deep well pumps. It is estimated that 25 years will be required to drain the entire field by this method, and it has been proposed to mine the sands and wash them in a surface plant after free drainage has ceased.

Books

Historical Geology of the Antillean-Caribbean Region (or The Lands Bordering the Gulf of Mexico and the Caribbean Sea).—By Charles Schuchert. Published 1935 by John Wiley & Sons, Inc., New York. 811 pages; 123 maps and other illustrations. $10.00.

This book on the general geology, the diastrophism and paleogeography of the Antillean-Caribbean region is a remarkably complete study of the area. It should be of great value to petroleum geologists working the Gulf Coastal area of the United States, in Mexico, in Central America, in Northern South America, and the Islands from Cuba to Trinidad. The book is beautifully illustrated with geological maps, otherwise available only in hundreds of different books, not accessible to the general public except in a few libraries. The paleogeography of the Central American Antillean region is summarized in 16 excellent maps from Middle Pennsylvanian time to Upper Pliocene—Pleistocene time. The work comprises four sections:

I—Introduction and Summary. This section includes general introduction; the greater geological features; diastrophism and paleogeography. II—The Three Middle American Basins. This section discusses the ancient Caribbean Mediterranean Sea, the Antillean Sea and the young Gulf of Mexico. III—Biogeography. This section discusses the detailed biogeographic evidence. IV—The Lands. This section covers in great detail the geological features of Mexico; Gulf Coastal Plain of the United States; Central America; the Antilles and Bahaman Foreland; the Isthmus; Northern South America (including Colombia, Venezuela, Trinidad, Barbados and Tobago); and the Oceanic Islands.

Petroleum Technology, 1935.—By numerous contributors; published 1936 by Institution of Petroleum Technologists, London; 263 pages, 6 illustrations. 8s.

In this work more than 2,000 selective references are given to books, periodicals, patents and other literature relating to the technology of petroleum. The ground covered is indicated by the chapter headings: Geology of Petroleum; Geology of the Oil Fields; Geophysics; Drilling; Production Technique; Refining in France; Chemical and Physical Refining; Cracking; Natural Gas; Natural Gasoline and Liquefied Petroleum Gases; Light Distillates; White Spirits and Kerosene; Aero Engines; Automobile Engines; Asphalt and Road Materials; Special Products; Analysis and Testing; Engine Testing of Gasolines and Diesel Fuels; Chemistry of Petroleum; Motor Benzole; Low Temperature Carbonization and Retortable Oil-Yielding Materials; Petroleum Literature; Statistics. Names and subjects are in separate indexes. It is intended to make this summary an annual affair and thus provide a convenient source to which investigators can turn for a record of previous research.

Official Nomenclature Map of the Mid-Continent Area.—Published by E. C. Jacobson, 530 McBirney Bldg., Tulsa, Oklahoma, size 66″ x 90″, scale 1″=12 miles, blue line on linen, attached to heavy spring roller in dust proof steel case. Price $75.00.

This map shows exact outlines of oil fields in green and gas fields in red, is hand-colored, with indexes giving location of each field and official name as designated by the various state nomenclature committees; also shows cities, towns, county seats, and principal streams.

The area covered is the eastern portion of Colorado and New Mexico, southwest portion of Nebraska, states of Kansas, Oklahoma, and Texas, southwest portion of Arkansas, and west portion of Louisiana.

This is the most complete and accurate map of this type that has been published to date, and the states of Kansas and Oklahoma have been approved and adopted as official by the Nomenclature Committee of the Mid-Continent Oil and Gas Association, Tulsa, Oklahoma.

Geology of the Tampico Region.—By John M. Muir. Published 1936 by American Association of Petroleum Geologists, Tulsa; 280 pp., 40 figs., 15 plates, with 6 geographic and geologic charts. $4.50.

In an introduction by L. W. Stephenson this book is described as the first serious attempt to assemble under one cover the existing knowledge of the geology of the Tampico region of Mexico, a difficult undertaking for which Mr. Muir's long familiarity with the region and his contacts with persons interested in the geology and oil resources of the region has qualified him. He has brought together an immense amount of data, as is attested by the bibliography of 212 references that are appended, and by the results of his own studies begun in 1928. His original intention was to describe the oil fields rather fully and to give only a résumé of the stratigraphy, but the final outcome appears to have been the reverse. At that, the author admits that he has not told all he knows about the stratigraphy and oil production, as some of his information is confidential.

The book is divided into sections on History, Topography and Drainage, Stratigraphy and Paleontology, Igneous Rocks and Seepages, and General Structural Features and Structure of Oil Fields. Oil field temperatures are discussed in an Appendix. The book evidently constitutes a valuable systematization and extension of knowledge of this interesting region.

World Oil Production—Official Figures for 1935 and 1936 Revised

All figures furnished direct to WORLD PETROLEUM by governments, except where otherwise specified.

(Figures in U. S. Barrels—Conversion ratio 7 bbl. = 1 ton)

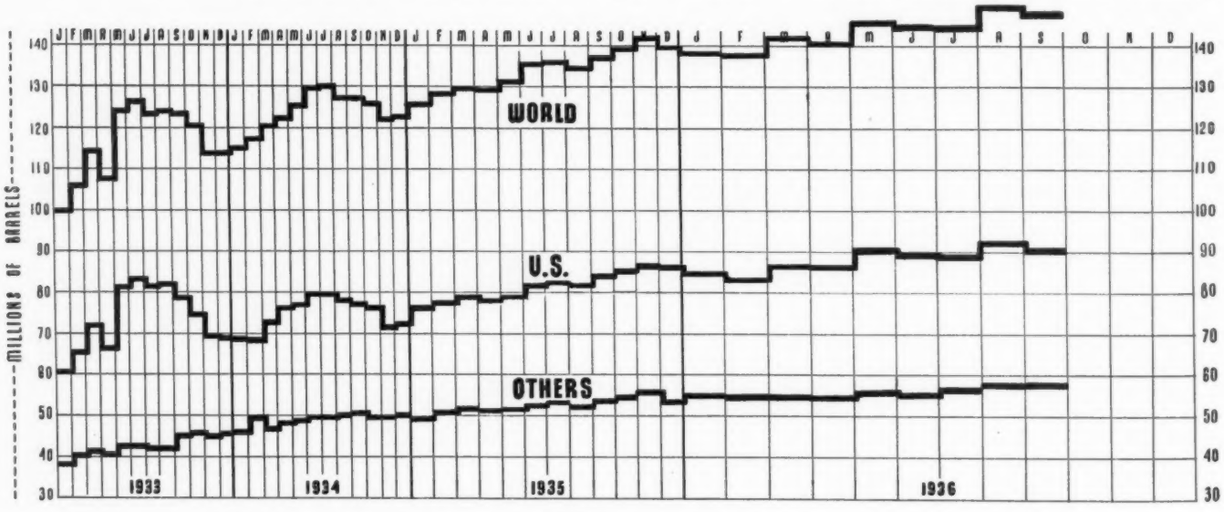
Country	October 1935	November 1935	December 1935	January 1936	February 1936	March 1936	April 1936	May 1936	June 1936	July 1936	August 1936	Provisional Figures September 1936
United States	88,160,000	86,475,000	88,711,000	88,820,000	82,120,000	90,568,000	90,479,000	93,739,000	90,185,000	92,078,000	95,090,000	90,972,000
Russia	16,040,500	16,050,000	16,100,000	16,155,300	15,288,700	16,344,300	15,589,000	16,454,200	15,955,100	15,680,000[1]	15,600,000[1]	15,400,000
Venezuela	13,681,619	13,152,766	13,389,789	13,487,089	12,849,480	13,432,671	13,442,870	13,722,933	12,486,600	14,566,510	14,632,737	14,626,073
Roumania	5,181,000	5,215,000	5,361,000	5,242,000	4,809,000	5,209,000	5,226,000	5,568,000	5,563,000	5,606,000	5,585,000	5,254,000
Iran[2]	4,109,000	4,522,000	4,816,000	4,627,000	4,480,000	4,641,000	4,312,000	5,376,000	5,061,000	4,872,000	5,117,000	4,697,790
Netherland India	3,767,596	3,528,889	3,612,056	3,614,436	3,407,194	3,670,877	3,532,375	3,721,613	3,549,417	3,725,491	3,715,887	3,731,973
Mexico	3,461,457	3,340,713	3,666,265	3,377,302	3,285,965	3,542,088	2,997,883	3,235,255	3,167,300	3,179,614	3,773,503	3,768,849
Iraq	2,374,393	2,309,867	2,240,819	2,327,332	2,107,210	2,515,345	2,048,053	2,467,136	2,473,660	2,440,669	2,479,428	1,881,782
Colombia[3]	1,623,372	1,582,952	1,004,474	1,611,618	1,475,403	1,619,620	1,427,193	1,598,544	1,529,901	1,585,345	1,553,606	1,575,273
Peru[1]	1,493,236	1,343,848	1,381,031	1,377,006	1,293,627	1,351,810	1,403,626	1,500,485	1,452,306	1,524,303	1,527,072	1,478,482
Argentina	1,200,698	1,193,434	1,304,554	1,310,129	1,273,243	1,366,691	1,260,277	1,231,354	1,140,080	1,284,299	1,312,199[1]	1,269,870
Trinidad	1,015,492	1,078,957	1,086,530	1,079,082	983,424	1,081,191	1,026,423	1,066,728	1,078,186	1,121,583	1,108,969	1,126,420
British India	790,612	649,041	841,764	854,644	756,384	791,162	790,376	827,762	778,947	799,924[1]	799,924[1]	786,780
Poland	308,000	294,000	308,000	338,800	323,400	338,800	323,400	331,100	287,000	294,000	301,000	294,000
Brunei	233,310	242,900	274,540	253,400	237,930	257,250	270,900	225,890	206,780	266,700	275,310	257,040
Germany	232,659	236,789	263,879	254,492	227,444	274,393	246,519	244,552	256,613	272,699	257,859	255,556
Japan	158,165	145,749	147,827	183,651	165,877	196,569	194,167	203,071	198,387	206,284	221,139	220,833
Sarawak	148,400	141,400	140,700	139,300	127,050	136,290	130,900	134,610	128,660	130,200	129,150	122,010
Ecuador	147,449	143,518	146,541	148,980	138,721	162,125	159,666	163,855	156,703	163,714	160,914	158,857
Canada[5]	122,525	116,756	125,658	121,231	107,928	117,824	107,748	114,297	114,050	139,940	139,789	135,624
Egypt	103,341	96,495	94,969	91,497	97,573	111,846	101,038	107,989	106,694	106,260	102,620	98,812
France[1]	44,981	43,530	44,981	44,981	42,079	44,981	43,530	44,981	43,530	44,981	45,000	45,000
Bahrein[1]	105,400	105,400	105,400	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Others[1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	144,578,205	142,084,014	145,242,777	145,834,270	135,972,632	148,148,833	145,487,944	152,454,355	146,293,914	150,463,516	154,303,106	148,532,024

[1] Estimate. [2] Anglo-Iranian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] International Petroleum Company's figures. [4] International Petroleum Company and Lobitos Oilfields Ltd. figures. [5] Includes natural gas production.

Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan.

Official Crude Oil Production Figures for 1932 to 1936

	Daily Average to Sept. 30 1936	Daily Average 1935	Daily Average 1934	Daily Average 1933	Daily Average 1932	Total to Sept. 30 1936	Total 1935	Total 1934	Total 1933	Total 1932
United States	2,969,665	2,723,129	2,490,704	2,462,670	2,145,243	813,688,250	993,942,000	909,107,000	898,874,000	785,159,000
Russia	519,951	469,608	462,051	407,950	409,070	142,466,600	176,688,100	168,648,700	149,901,900	149,719,000
Venezuela	449,806	421,733	385,712	331,186	326,766	123,246,963	153,932,611	140,784,805	120,882,802	119,596,512
Roumania	175,409	167,534	169,879	139,647	137,954	48,062,000	61,150,000	62,006,000	50,971,200	50,491,205
Iran	158,065	143,600	144,284	135,840	123,285	43,309,790	52,413,879	52,663,782	48,581,280	45,122,455
Netherland India	119,231	116,629	115,861	105,516	108,153	32,669,263	42,569,625	42,289,408	38,512,663	39,584,027
Mexico	110,685	110,233	104,567	92,890	89,624	30,327,759	40,234,902	38,167,022	33,904,882	32,802,285
Iraq	75,696	68,085	21,742	3,288	3,300	20,740,615	24,850,924	7,935,657	1,200,000	1,200,000
Colombia	51,009	48,740	47,509	36,047	44,768	13,976,503	17,617,654	17,340,724	13,157,127	16,834,956
Peru	47,112	46,270	43,663	38,146	26,026	12,908,717	16,835,206	15,936,937	13,923,281	9,899,266
Argentina	41,417	39,226	39,015	38,232	35,975	11,348,142	14,317,500	14,045,652	13,759,565	13,166,900
Trinidad	35,299	31,686	29,847	26,192	27,387	9,672,006	11,669,792	10,894,363	9,560,039	10,023,780
British India	26,226	25,281	24,650	23,893	23,500	7,185,903	9,227,496	8,997,399	8,721,655	8,600,312
Poland	10,360	10,885	10,130	10,570	10,670	2,838,500	3,973,200	3,697,617	3,858,085	3,905,230
Brunei	8,215	8,647	7,323			2,251,200	3,162,614	2,673,041		
Germany	8,358	8,409	6,211	4,692	4,983	2,290,127	3,054,023	2,266,964	1,712,823	1,824,019
Japan	6,533	5,065	4,068	3,827	4,375	1,789,978	1,848,656	1,484,962	1,337,761	1,575,333
Sarawak	4,300	5,002	5,337	6,273	6,213	1,178,170	1,811,297	1,948,044	2,289,472	2,274,043
Ecuador	5,159	4,727	4,534	4,446	4,300	1,413,535	1,725,354	1,655,062	1,622,624	1,573,857
Canada	4,009	3,933	3,887	3,144	2,880	1,098,431	1,434,467	1,418,810	1,147,825	1,054,373
Egypt	3,373	3,356	4,052	4,360	4,760	924,329	1,215,606	1,479,037	1,591,495	1,742,370
France	1,456	1,451	1,512	1,515	1,508	399,063	529,664	552,000	552,000	552,000
Bahrein	9,854	3,465	781			2,700,000	1,264,809	285,071		
Others	2,464	2,470	2,359	1,184	1,180	675,000	900,000	861,000	432,000	432,000
	4,843,653	4,470,161	4,129,678	3,884,022	3,544,940	1,327,160,844	1,636,369,379	1,507,139,057	1,417,534,479	1,296,682,923



World crude oil production by months, 1933–1936. Chart is weighted to compensate for variation in number of days per month. Ratio of U. S. crude production to world production.

U. S. S. R.

Official Figures for Soviet Oil Operations

	Crude Production (bbl.)	Daily Average (bbl.)	Runs to Stills (bbl.)	Drilling (feet)
January	16,155,300	521,139	13,993,000	509,956
February	15,288,700	526,955	13,055,700	516,140
March	16,344,300	527,236	14,259,700	610,306
April	15,589,000	519,633	13,418,300	619,420
May	16,454,200	530,781	14,356,300	621,911
June	15,955,100	531,837	14,365,400	510,860
July	15,680,000	506,000	14,100,000	560,000
August	15,600,000	503,230	14,150,000	550,000
September	15,400,000	513,334	14,250,000	510,000
Total 9 months 1936	142,466,600	519,950	125,948,400	5,008,587
Total 9 months 1935	128,497,600	470,596	105,365,700	3,505,093
Total 1935	176,688,100	497,713	146,705,100	4,868,465
Quota 1935	212,310,000	581,672	171,500,000	5,214,000
Quota 1936	213,500,000	584,931	175,000,000	7,100,000

Crude conversion: seven bbl.=one ton.

FROM the statistical showing of the Soviet oil industry for the first nine months of 1936 it is evident that while the drilling and refining divisions are making steady progress, the production division is falling behind, the gains made early in the year having been checked and offset by losses incurred since June. The total daily average production of crude and gas has dropped from 567,700 bbl. in June to 559,300 bbl. in July, to 547,400 bbl. in August, and to 533,400 bbl. in September.

Most of the Soviet oilfields outside of the Caucasus (together with Maikop of the Caucasian group) have reported considerable improvement in drilling and drilling speed. They were not only unable, though, to live up to plan fulfillment in crude production but also incurred considerable arrears, while operations have dropped to an alarming degree. The share of crude production from these fields to the total from all fields including the major Caucasian groups, however, does not exceed 12–14 percent and, therefore, the arrears incurred would not have mattered so much if the major Caucasian fields had been able to make up for all arrears incurred elsewhere, as has been the case during past years. But the Baku oilfields, the mainstay of Soviet crude production, are themselves in arrears and plan fulfillment has dropped from about 96 percent in June to 92 percent in July, 90 percent in August, and to 88–89 percent in September. Baku oilfields supply not only the refineries of Baku but also those of Grozni. Now, in addition, Baku crude has to be shipped to refineries along the Volga, and a number of other Soviet refineries which have heretofore obtained crude from fields other than from Baku will now (due to the drastic losses of crude production outside of the Caucasus) have to fall back on Baku for crude supply which, of course, only aggravates the situation.

Of all Baku oilfield groups only the Lenin and Ordzonikidze fields were in a position to live up to plan fulfillment during September. The other groups show plan fulfillment of between 80 and 94 percent and the Molotov group shows even less, producing on individual days as low as 65 percent of the plan. Grozni operations have been stabilized for many months past at the rate of 82–84 percent. Other Soviet fields show the following plan fulfillment for the month of September: Bashkiria, 80–86 percent; Emba, 48–53 percent; Turcomania, 48–55 percent; Middleasia, 30–58 percent; and Sakhalin, which was recently reorganized and the entire management changed now shows plan fulfillment of 8–12 percent in excess of quota as against the former 15–18 percent below quota.

In order to save face efforts will be made to increase crude production during the last quarter of the year (October-December) to a total of about 57,000,000 bbl. for the period, which will require a daily average of about 620,000 bbl. This should not prove too difficult with drilling operations considerably increased and drilling speed augmented, but the season of the year has to be taken into consideration. At this time of the year some of the roads become impassable and some of the fields inaccessible, and cold weather is not much of an aid to operations.

FOLLOWING the conferences under the auspices of the Commissariat for Soviet Heavy Industries (held at Moscow during August and September in connection with the reports of the Barinov commission on their visit to the oilfields of the United States), S. Ordzonikidze, People's Commissar for

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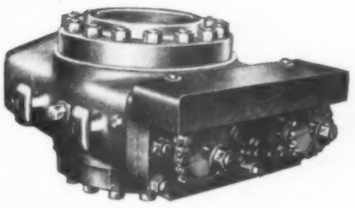

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Heavy Industries, issued an order (Moscow, September 5, 1936) to bring the Soviet oil industry again under sound working conditions. This order, which is given below in abbreviated form, gives an outline of the present position of the Soviet oil industry and shows the shortcomings as well as their causes and states definitely how to relieve the situation.

"During the first eight months of the Stakhanov year (1936) the Soviet oil industry has decidedly progressed in production and drilling, particularly in drilling speed, and individual accomplishments of Stakhanov drillers at Baku, Grozni and Maikop are undoubtedly conclusive of potential Soviet possibilities. However, in spite of this progress, Soviet crude production has been on the downgrade during recent months. Operations at Maikop, Emba, Middleasia and Turcomania are decidedly unsatisfactory and jeopardize plan fulfillment for the year. Baku and Grozni fields which started the year with fair prospects for exceeding the plan have fallen out of line, have reversed the trend and are in considerable arrears.

"The main causes of these shortcomings lie primarily in lack of flexibility of the management—failure to switch to new methods of operation at all old oilfields, failure to bring new fields under production, and lack of initiative in making the fullest utilization of all equipment at hand.

"Geological prospecting operations lack geophysics and are being carried on haphazardly without adequate returns, drilling continues with insufficient and inadequate equipment at exceedingly low drilling speed. Under-water drilling and drilling at Podnadvig depths is attempted without use of directional drilling. Bringing new oil regions under production is being delayed until the erection of electric power supply, housing, roads, repair shops. While awaiting electricity as the source of power, no steam is being used at all and no provisions are being made for the extensive use of portable equipment. Numerous wells completed are not being operated and over 2,000 wells are now idle. Deep pumping, compressor production, etc. are under exceedingly low efficiency, no use being made of internal combustion engines which are to be had in sufficient numbers—all these and many other shortcomings are keeping back the expected and necessary progress of crude production. Drilling equipment for both production and prospecting does not give effective results and no steps are being taken to overhaul or to remodel the equipment in line with requirements. Instead of replacing worn out parts equipment is being repaired in primitive repair shops, which not only slows up operation but adds considerably to costs. Cost of drilling is on the upgrade and, compared with estimates for the first eight months of the year, drilling expenses were exceeded 19.2 percent (over 17,000,000 Rbl.) for Baku prospecting and 27 percent for prospecting at Bashkiria.

"In order to remove these deficiencies, to bring crude production in line with requirements and to facilitate the fulfillment of the plan, it is deemed necessary cardinally to change the methods of operation of the Soviet oil industry. Drilling must become more effective and action must be taken toward the bringing of new oil regions under operation. No more delay should take place because of lack of electrical power. Steam should be used extensively whenever conditions call for doing so and inner combustion engines should be used when necessary, utilizing all truck and tractor motors at disposal. Breakdowns at wells are to be lowered considerably and more flexibility should be brought in all operations generally and particularly in the utilization of the equipment available. Modern technique should be fully introduced under better and more effective management.

"In order to accomplish this and in line with the reports of the commission of M. Barivov, the Commissar for Soviet Heavy Industries has issued an order regarding future prospecting to the effect that during 1937 not less than 14 new oil regions must be brought under operation, while not fewer than 20 new oil regions must be prospected with a view to commercial development in 1937. These new developments are to be carried out along the following lines:

Soviet Oil Exports

Jan.–July, 1936

(tons)

	7 months 1936	7 months 1935
Crude Oil	179	9,516
Gasoline	260,749	405,714
Kerosene	227,652	237,827
Lube Oil	162,563	151,926
Diesel Oil	42,189	58,089
Gas Oil	302,701	288,432
Fuel Oil	521,346	729,478
Others	6,321	15,883
Total	1,523,700	1,896,865
Value in Gold Rbl.*	19,910,000	23,410,000

By Countries

France	244,073	219,011
England	174,764	181,935
Germany	139,949	271,786
Belgium-Luxemburg	92,356	72,917
Sweden	82,116	94,555
Spain	37,583	129,844
Japan	28,332	27,753
Iran	20,433	22,338
Other Major Countries	210,089	301,946
All others	494,003	574,780

*1 Gold Rbl.=87 cents.

The decrease against last year is: Quantity, 19.7 percent; Value, 15 percent.

Soviet Oil Operations—First 3 Quarters, 1936

	Crude Production (bbl.)	Daily Average (bbl.)	Runs to Stills (bbl.)	Drilling (feet)
Jan.-March	47,788,300	525,146	41,308,400	1,636,396
Apr.-June	47,998,300	527,455	42,140,000	1,752,191
July-Sept.	46,680,000	507,400	42,500,000	1,620,000

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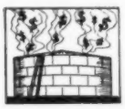

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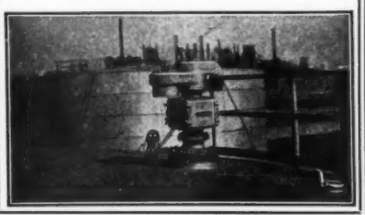

Kergezneft—to extend operations over Kergez, Shongar, Kiziltepe, and to produce in 1937 not less than 5,000,000 bbl. of crude.

Baku—to extend prospecting over Sarinch-Gulbak, Bozdag, Karadag, Khamadag, Khiderli and Bendovani, as well as Eldarovo, Kalaus and Adaurt, and to produce in 1937 not less than 3,500,000 bbl. of crude.

Grozni—to extend operations over the Daghestan properties and to bring under production the fields of Izberbash, Achisu, Kayakent and Makhatchkala, and to produce in 1937 not less than 7,000,000 bbl. of crude from these properties.

Maikop—to complete prospecting of Asphalt mountain as well as the Kutais properties and to extend operations over the Kuban-Blacksea region.

Bashkiria—to extend production over Ishimbayevo and Kuspiakulovo with a view to lifting in 1937 not less than 12,000,000 bbl. of crude and to complete during 1937 prospecting of a number of new districts so as to prepare sufficient land reserves.

Emba—to extend prospecting over East and North Iskine and a number of properties along the Guryev-Orsk pipeline, as well as along the Guryev-Kondagatch railway now under construction.

Vostokneft—to complete in 1937 prospecting of the Sizran properties as well as of Samarski Luka and the Krasnoyarsk structure at Orenburg.

Middleasia—to complete operations at Haudag and Utchkizil with a view of producing in 1937 not less than 5,600,000 bbl. of crude.

Turcomania—to prospect the properties of Hudaidag and Kundag and to start deep-drilling at Neftdag in the eastern and western directions.

Kamaneft—to complete prospecting at Krasnokamsk with a view of producing in 1937 not less than 420,000 bbl. of crude."

Definite and clear provisions were made by the order to facilitate drilling and to increase drilling speed by means of providing drilling bits of higher quality and improving the welding of bits. Strict orders were also given to do away with all breakdowns and cave-ins at wells and to undertake all necessary preventive repairs. Some changes were also made in the norms for the use of equipment. At wells drilling for depths up to 3,500 ft. (in prospecting) portable equipment only will be used, while for depths up to 4,500 ft. light equipment will be used. Electricity as source of power in the future will be used when available, otherwise extensive use will be made in drilling of steam and all other combustion engines. Or-

Soviet Heavy Industries

	% Plan Fulfillment; Sept.	% Plan Fulfillment; Jan.-Sept.
Tractors	100.0	89.5
Pig Iron	96.7	74.1
Steel	97.9	74.5
Trucks	97.6	60.0
Electric Power	96.0	74.4
Rolling Mills	92.5	74.3
Coal	88.2	69.2
Oil and Gas	86.2	72.3
Combines	86.9	61.2
Copper	84.5	64.7
Machine Tools	82.1	70.5

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ders for the supply of 200 steam boilers and 100 steam engines were given to domestic machine plants of Tuapse and to the Lenin Forge plant.

GLAVGORMASH has received an order for 150 steam pumps and 50 gas motors for use with compressors and 100 compressor aggregates with gas engines. GUTAP has received an order for 400 various motors—immediate delivery. AZNEFTMASH and GLAVGORMASH have received orders to start mass production of spare parts for all sorts of drilling equipment. GLAVSTANKOINSTRUMENT has received orders to provide for full supply of hard alloys of high quality in quantities necessary for the oil industry. GLAVREZINA has received orders to fully supply the oil industry with high quality rubber goods. GUMP has received orders to improve the quality of pipe necessary for the oil industry and to considerably increase the assortment of pipes. VOTI has to expand the output of measuring instruments and to improve the quality. RIKOV PLANT of Baku and Upper Sergiensk Plant have received orders to improve the quality of disc bits and to manufacture several more types of disc bits from high quality metals to suit all various formations in drilling.

The oil trusts have also received strict orders to take better care of all equipment at disposal and to fight with all force any negligence to all equipment already in use.

J. WEGRIN

Sir Henri Deterding Succeeded by J. E. F. de Kok as Royal Dutch Head

(Continued from page 594)

pany in 1908. A few months thereafter he was transferred to the London office and became secretary to Sir Henri Deterding. He served in that capacity until 1911 when he was sent out to California to represent the company's interests there. At that time California was short of light crude and considerable quantities of gasoline were imported from the Netherland India. Mr. van Eck's first task was to take charge of the distribution of this gasoline for his company.

Within a short time California developed light crude oil production and was able to supply sufficient gasoline to meet the needs of the Pacific Coast market. In 1913 the Royal Dutch-Shell interests purchased the holdings of California Oilfields Ltd. and began its expansion into an integrated company controlling production, pipelines, refineries and marketing which was to become the Shell Oil Company, now one of the principal operators in the Pacific Coast area. In 1919 Mr. van Eck became president of the California company. In the meantime Shell operations were being extended through the central and eastern portions of the United States. In 1923 Mr. van Eck moved from California to New York where he became vice president and subsequently president of the Shell Union Oil Corporation, which is the holding company for Shell interests in the United States. In October, 1933, he became vice chairman of the board of directors and chairman of the executive committee. In these positions he has been the actual head of Shell operations in the United States and has directed the work of consolidation which has been going forward during the past three years. On taking up his new duties, about January 1st, Mr. van Eck will establish his offices in London.

J. M. de Booy, third of the newly appointed managing directors, came to the Royal Dutch-Shell combination through Bataafsche Petroleum Company, a subsidiary of the Royal Dutch, which he joined in 1919. In 1927 he was sent to Venezuela as manager of that territory and remained there until 1932, when he was recalled to The Hague to serve as general attorney and assistant to Mr. de Kok. Though one of the younger members of the organization he is regarded as a man of exceptional managerial and organizing ability.